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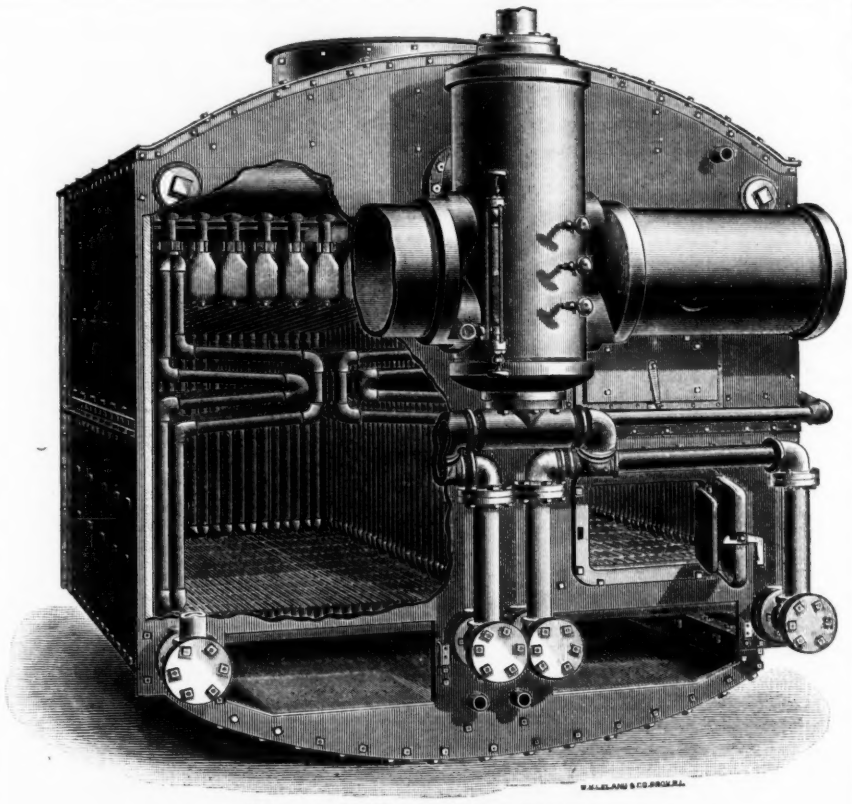
New Almy Water Tube Boiler.

The accompanying illustration shows the construction of a water tube boiler which embodies a number of original features and has proven very successful in a number of peculiarly trying situations, especially where a boiler is required to generate a great deal of steam within a short space and with little weight of boiler, an instance of this being in the case of the government torpedo boat "Stiletto," in which the boiler shown, weighing 5½ tons, has been found capable of supplying steam for a triple-expansion engine indicating 550 to 600 horse-power when driven with forced draught.

The heating surface in this boiler is composed of 1" steel pipes which are disposed as shown, making their turns with bends and elbows connecting to four-way branch fittings, and these are connected by a union to flange nipple at top and bottom manifolds. There is a manifold in the form of a rectangle below the grate with a mud drum in center at the back cross-section which forms the base of each furnace. The top manifolds are four sections running parallel, connecting into an enlarged header across the front.

The elements which rise from back of boiler extend across at right angles to heating surface, forming the crown of fire box. Between the vertical pipes which form middle wall of furnace is placed a wall of fire-brick which completely divides the two furnaces. There are 14¼ square feet of grate surface in each furnace, and 70 square feet of heating surface subjected to radiant heat of furnace, with a total heating surface of 1,100 square feet.



NEW ALMY WATER TUBE BOILER.

Each of the elements which form the side and crown of fire box can be removed from the furnace without disturbing the casing, by simply removing the grates and unscrewing union at top and bottom; the fore and aft section can be removed from the back. There is ample room to get to top end of all the elements from back of boiler by removing a small section of casing arranged for that purpose. The whole internal heating surface of boiler may be removed and replaced from front of boiler without taking down separator or disturbing the top manifold or casing, except the front sheet.

The arrangement of heating surface is such that the gases, after leaving furnace, have to pass at right angles to heating surface, and through very narrow channels, which bring them in contact with the metal.

Another point in this arrangement of heating surface is that it is all water surface from the grate line to the vertical nipples which connect to top of manifold. Each element is independent of the other, and can be stopped off or removed very easily, and the boiler can go on with its work with but a short interruption.

It will be noticed that the fire box walls are composed of double rows of tubes, which very much increases the heating surface relative to the weight and grate surface, besides making the circuits short and the pipes of small diameter, thus permitting the boiler to be driven very hard when occasion demands it.

The system of pipes when completed is cased in either sheet-steel or iron, lined with asbestos, the fire box being in addition lined in front with fire-brick. This casing is made in sections and bolted to angle-iron in such a way that any section may be readily

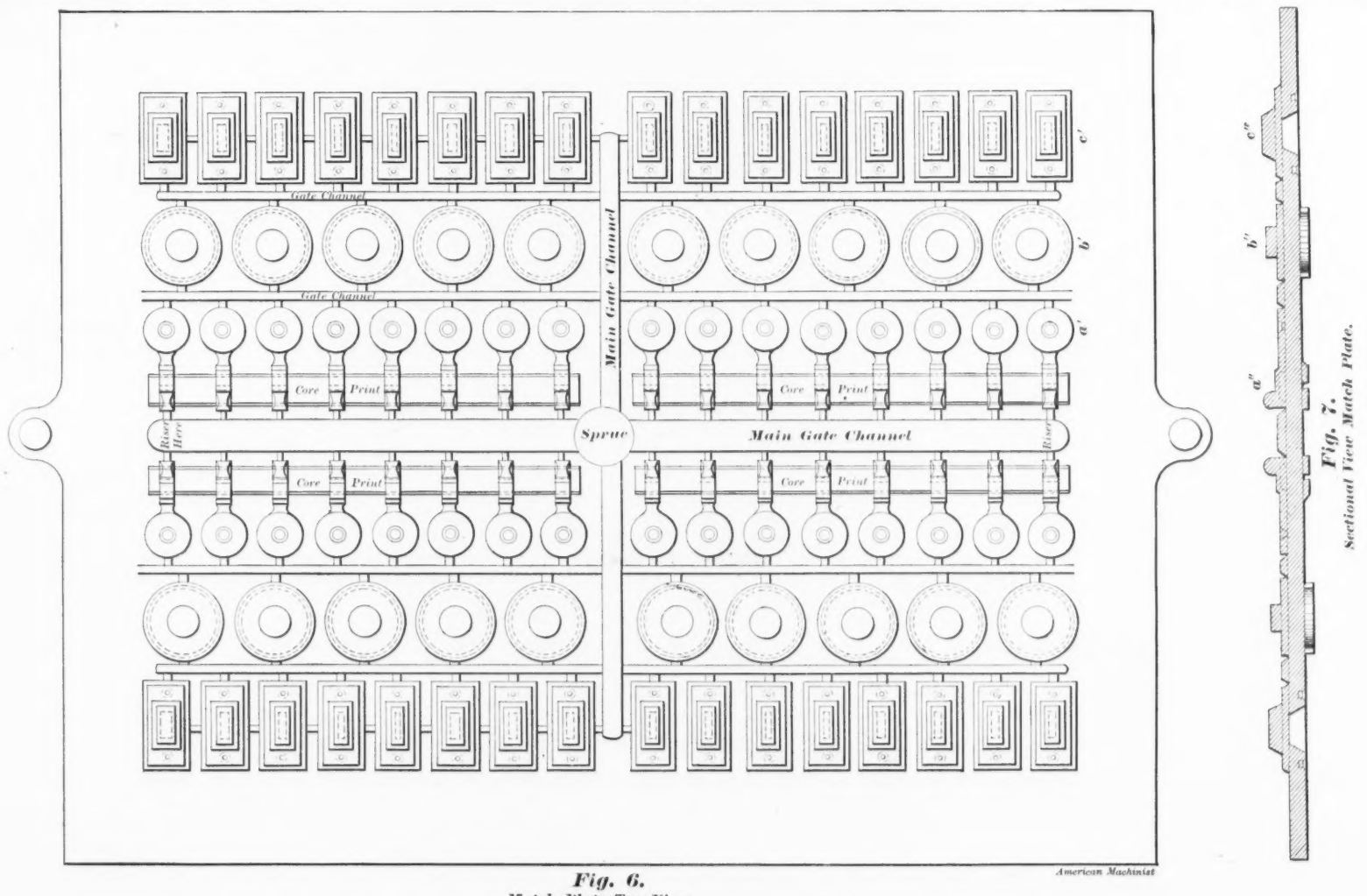


Fig. 6.
Match Plate Top View

Fig. 7.
Sectional View Match Plate.

RUBBER PATTERN WORK.—SEE PAGE 2.

removed, enabling repairs to be made without trouble.

The water is fed to the boiler in such a manner that it is subjected to the heat of the escaping gases just before they reach the flue, which, of course, conduces to economy and efficiency.

Steam is taken through a separator which is placed in front, and which operates on the centrifugal principle for the separation of water from the steam, if there be any present.

A jet of steam or hot water introduced through openings in the casing effectually cleans all soot and ashes from the pipes; the boiler is what is called non explosive, *i. e.*, it is capable of carrying far higher pressures than those designed for it, and in case of the failure of a tube the consequences are not likely to be serious, especially since the section in which the failure occurs can be stopped off, and the balance of the boiler will go on performing its duty.

One of the special points claimed for the boiler is the cool fire room which it is possible to have when using it, very little heat being radiated from it, and in fact it can be set quite close to woodwork without danger. The water level is very steady, and it is found that there is no "swashing" nor priming.

Repairs at sea are readily made, especially if there is carried on shipboard an extra section which can be put in place of any which may fail; but if this is not done then any section can be stopped off until repairs can be made by substituting new tubes.

The boiler steams very quickly, it being possible to get steam in from 10 to 20 minutes. Many tests have been made by marine engineers and other disinterested persons, to determine rate of steaming, economy, etc., and with results very flattering to the Almy boiler.

Its builders are the Almy Water Tube Boiler Co., Providence, R. I.

Rubber Pattern Work.

BY J. T. USHER.

SECOND PAPER.

Fig. 5 shows sectional views of three castings for dissimilar purposes, but which, on account of their being familiar objects everywhere, have been selected, and are well adapted to convey the idea intended as to how patterns can and should be arranged and grouped together on a match plate, and also the gating of the same.

a and *a'*, Figs. 5 and 6, show sectional and top views of a catch or fastener for shutters, and are intended to illustrate the adaptability and application of patterns (that would otherwise be split or have single core prints) to match plate work, and also the possible arrangement of the core prints for this and a variety of other cored work, one core serving for eight castings, thereby obviating the necessity of making a separate core for each.

In Figs. 5 and 6, *b* and *b'* show sectional and top views of a lubricator cap or cover, and furnish another example where a pattern (a portion of which must be molded in each half of the flask) can be readily adapted to the match plate.

At *c* and *c'* are shown sectional and top views of a nosing, or that portion of a lock which is fixed opposite to it, to receive the bolt of the lock when a door, etc., is locked. This and most hollow hardware of a similar description is the only class of iron work that can be said to be specially adapted to match plate work, though somehow this class of patterns are generally grouped independent of either plate or card, first, because "match plates" are not so generally known and appreciated as they deserve to be, and, secondly, because card patterns are somewhat more expensive and difficult to make.

The two former examples *a a'* and *b b'* are equally adapted to "card patterns" as to "match plates," but the latter class of patterns could not be so easily arranged on a card, except as grouped patterns, which will be explained later on.

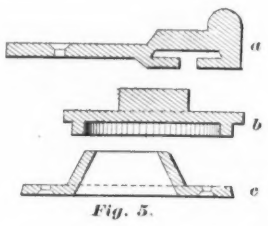


Fig. 5.

Fig. 7 is a sectional end view of match plate, serving to show at a glance how the patterns appear in and on each side of the plate.

The arrangement of the gates can be changed, and the intermediate gates on the outer rows entirely dispensed with if desired.

Fig. 8 shows sectional views of three castings used in combination for the same purpose, the whole forming, when machined and fitted together, a piston or plunger for a pump.

The valve *A*, valve box *B*, valve seat *C*, and guide bushing form part of pump plunger; the dotted lines *a a a* show where the bushing *C* is subsequently machined, and at *b* where it is threaded to pass through and screw into the valve box *B* at *b'*; the bushing is also faced off on the upper surface, and bored out to form the valve seat and guide for the valve *A*, which is enclosed

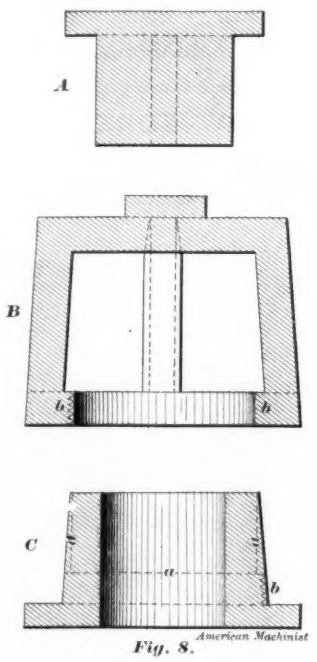


Fig. 8.

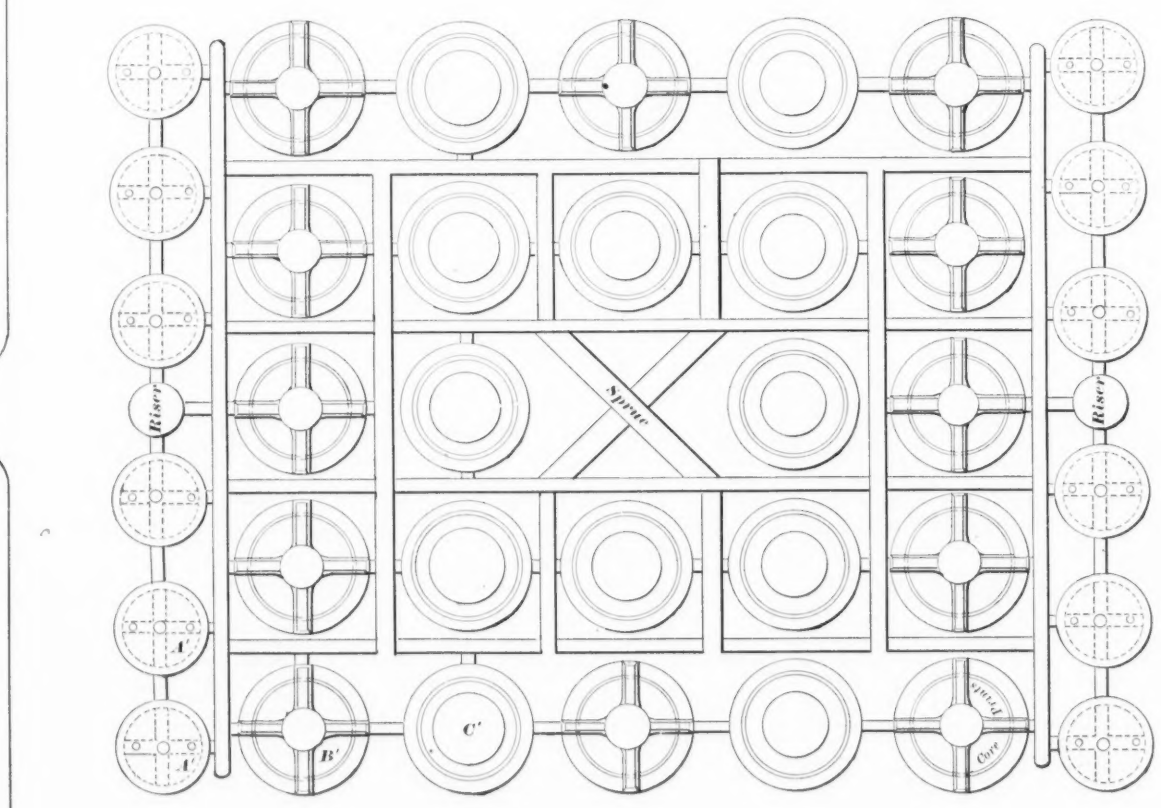


Fig. 9.

Scale ¼" = 1"

Top View Card Pattern.

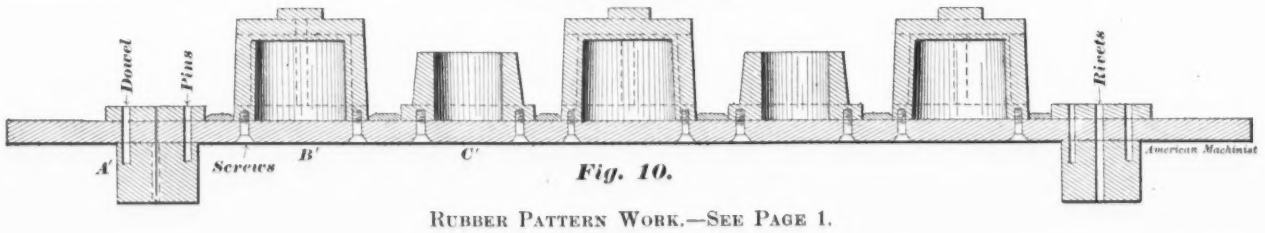


Fig. 10.

RUBBER PATTERN WORK.—SEE PAGE 1.

cases. The patterns *A*, Fig. 10, show the manner of dividing patterns for carding.

Fig. 10 shows a sectional side view of patterns as arranged on card. The gating on the card, Fig. 9, is intended to show the different methods of gating carded patterns.

CARD PATTERNS.

A card pattern, Figs. 9 and 10, differs somewhat from a match plate, by reason of its having all the patterns thereon attached to the card or plate by screws or rivets, or both, as the case may be. They are also limited to such forms of patterns as can be attached or fixed to a plane surface, or where the dividing line is in such position that each of the two parts of a split pattern can be attached to a plane surface, but upon opposite sides of a card or plate. To properly fit up a card pattern requires considerable time and accurate workmanship. This method of making patterns is never considered economical from the pattern maker's standpoint, but this is only a secondary consideration, the real economy resulting from the amount of patterns that can be grouped together on a single card, and consequently the amount of castings molded in each flask. The number of flasks that can be put up each day is in most cases almost incredible to those not acquainted with this class of patterns and molding.

In one instance I received an order to put up a card of a certain pattern. The molder making the castings had 16 single patterns, and would make 16 castings in each flask, and put up 60 flasks a day, making a total of $16 \times 60 = 960$ castings a day. I made a card and grouped 48 patterns thereon, and the same molder would put up from 80 to 100 flasks a day, making a total of (taking the lowest figure) $80 \times 48 = 3{,}840$ castings a day, a difference of 2,880 castings a day. As it did not pay in this instance to fix up the broken molds, there was a loss of about 1½ per cent. on each day's work, and about 58 or 60 castings. Then $3{,}840 - 58 = 3{,}782$, or a difference of 2,822 castings a day without making any allowance for loss from the same cause in the first instance.

In almost every instance where patterns can be carded a man can do from one hundred to four or five hundred per cent. more work in a given time than the same man could accomplish using single patterns.

MAKING CARD PATTERNS.

To make a card pattern, a card or plate is first made of the dimensions of the outside of the flask (including the lug or portion for the guide pin hole) with which it has to be used, and made preferably of cast-iron. The card is then planed on both sides until it is of the thickness required, in ordinary practice from $\frac{5}{16}$" to ½"; the card is then laid out in spaces, each space to be of such dimensions as will admit of one pattern being placed therein, with one-half on each side of

whatever allowance is required to be between this and the next pattern for gating, etc. If more than one kind of patterns are to be attached to the card, the larger or heavier patterns are located on the outside row (near the outer margins), so that as much as possible of the weight may be borne by the flask, and to prevent any undue springing of the card in ramming up the mold, though this is in part or entirely obviated by the use of a follower board. The patterns are then finished to size ready for attaching to the card. It is advisable, where possible, to do as much of the finishing of the patterns on the machines as can be done.

Less allowance is always made on carded patterns for castings that have to be machined and finished by hand than would be the case where single patterns are used, as castings made from carded patterns are always truer than if made with single patterns.

There is no occasion to give any special instructions for finishing metal patterns that are to be carded; they are finished to size, the same as any other piece of mechanical work would be.

Patterns that can be drawn from one side of the mold (as the patterns *a a''* or the follower board, Figs. 1 and 2, October 15,) are attached or fixed to one side of the card only; but patterns, any portion of which is molded and cast in both sides of the flask (as *b b c'* and *c c'*, also shown on the follower board, Figs. 1 and 2) must have one-half or part of such patterns placed on each side of the card.

In fitting up patterns of the latter description the two parts are first fitted together, and the dividing line mentioned above must in all cases be used as a basis from which all other measurements are to be made before any other fitting is done. On this class of patterns the parts must be closely fitted together and doweled, using dowel (or guide pins) of some particular gauge or standard size. As these dowel pins are merely temporary pins, in attaching or fixing the patterns to the card, they are withdrawn from the pattern and other pins inserted, the length of which is in all cases sufficient to connect or locate the two parts of the pattern through the card. In some cases these dowel pins are continued right through the parts of the pattern and then riveted. In other cases additional holes are drilled in each portion or part of the pattern, on one side for tapping and on the other side for clearance of the screws to be used for fastening or attaching the two parts of the pattern to the card, the dowel pins serving to locate each part in its relative position to the other part (through the card); the part of the pattern that is drilled for clearance of the screws must also be countersunk deep enough to receive the head of the screw (allowing the same to be level with the outer surface of the pattern when the holes are drilled).

To fasten or attach patterns that are to be placed on one side of the card only, two or three tapping holes are drilled in the patterns, and the clearance holes are drilled in the card; these latter holes are then countersunk on the opposite side of the card (to that on which the patterns are to be fastened), deep enough to allow the screw heads to be level, or a trifle below the plane surface of the card.

The patterns having been all fitted, the screw holes tapped, and the clearance holes drilled and countersunk in the card where required, the patterns are now attached or fastened to the card in their relative positions.

The next thing to be done is to make and fit the patterns for the gate channels; these are made to connect at the most convenient point of the patterns (as forearranged), and also to connect each pattern with the next one, to insure each having the necessary amount of metal in casting and to facilitate the pouring of the mold; these latter gates are always made smaller than the main gates, and in some cases are not used at all.

The proportions for the gate channels should be such as would be used by practical foundrymen, care being taken not to exceed what would be considered good practice.

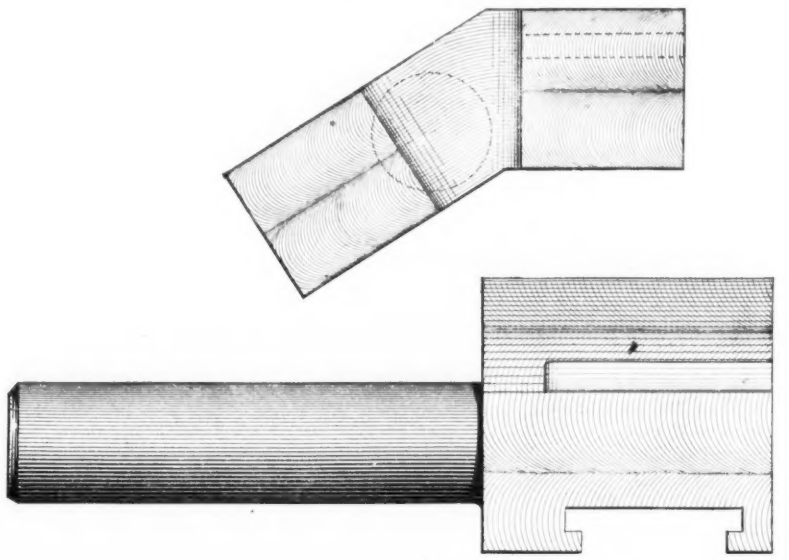


Fig. 6.

In most cases these gate channel patterns are placed on one side of the card only, but they are occasionally split or divided, and one-half placed on each side of the card in the same way as the patterns; these gate channel patterns are frequently made of wood, and shellaced before being fastened on the card, in the same manner as single patterns with screws. After the patterns and gate channel patterns have been fastened or attached to the card with the screws, the countersunk holes and grooves in the screw heads, and then soldered level with the pattern and card, as the case may be, they are then coated with the preparations of bees' wax, etc., mentioned before for coating match plates, or they may be electroplated, or galvanized, or tinned, as preferred.

In molding with match plates or card patterns, the plate, or card, is placed between the two halves of the flask; first one and then the other half is molded (including the sprue channel), the same as with ordinary patterns. The mold is then opened, the plate or card lifted out of the sand or mold, the mold faced up and closed, and it is ready for pouring; no attention is generally paid to a broken or defaced mold. In most cases a new mold can be made in less time than a broken or defaced mold can be patched up, or the broken molds can be stopped off by filling the gate channels with sand. Card patterns are sometimes made entirely of wood, and also with a wooden card and patterns of other materials.

Some Points on Milling Machines.

In our issue of November 19 we mentioned the fact that a new edition of the Brown & Sharpe Manufacturing Company's book, "Construction and Use of Milling Machines," had been published, containing much new and interesting matter. From its pages we have selected a few of the new engravings, which we publish herewith.

Fig. 1, instead of showing what we intended to show, *i. e.*, the new arrangement of feed pulleys, shows the old arrangement, this being due to a mistake arising from the similarity of the two cuts and which was not discovered until too late to make any change. The proper engraving will be published next week.

In this book a new classification of milling cutters is proposed, by which all cutters are placed in one or the other of four distinct classes. The first of these classes is called "axial," which is defined as a cutter that cuts flat surfaces parallel to its axis. An example of an axial cutter is given in the engraving, Fig. 2, and to this class belong all cutters of this nature, whether with straight or spiral teeth.

Radial cutters are defined as those which cut a flat surface perpendicular to the axis. An example of such a cutter is given at Fig. 3. Any cutter which makes a similar cut belongs to this classification, including those which are composed of a large cast head in

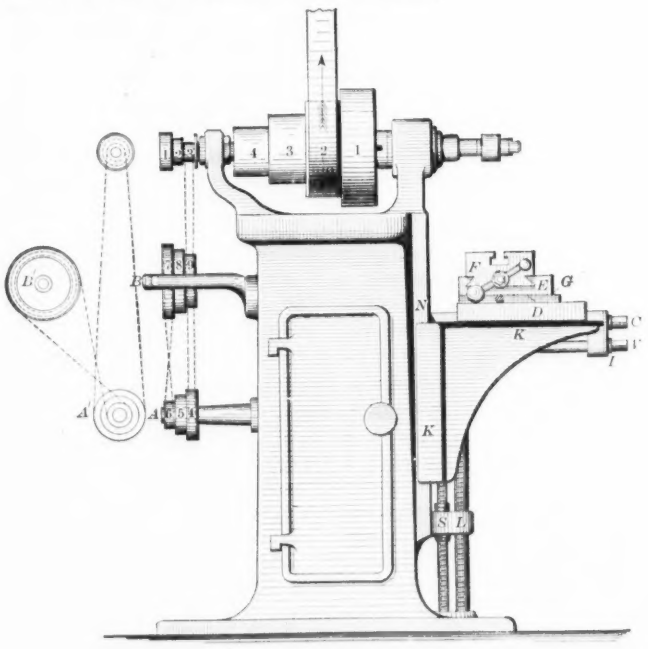
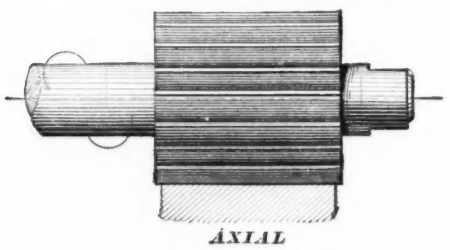
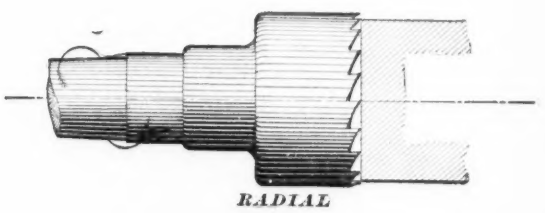


Fig. 1.



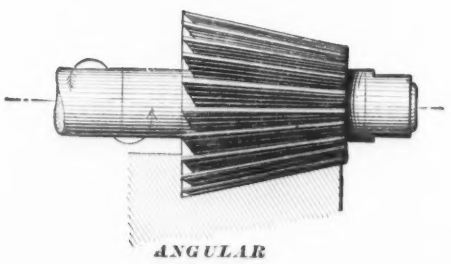
AXIAL

Fig. 2.



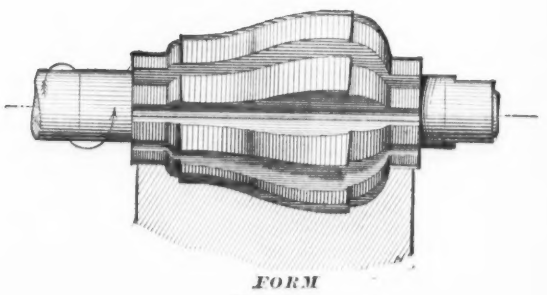
RADIAL

Fig. 3.



ANGULAR

Fig. 4.



FORM

Fig. 5.

SOME POINTS ON MILLING MACHINES.

which inserted teeth are used. The third class is called "angular," and to it belongs every cutter that cuts flat surfaces at any angle to its axis, except a right angle. A type of this class is given at Fig. 4, and the class includes all angular cutters of every kind.

The fourth class is called "form," an example of which is given at Fig. 5.

Regarding this matter, the book says: "Distributing the various kinds of cutters under the several heads of this classification milling cutters, screw slotting cutters and saws are axial mills. Inserted tooth mills, end mills and side milling cutters are radial mills. The two last, however, are also axial, and should be termed such when the axial teeth are to be used in dressing the work. Angular and form mills naturally appear under the proposed classification.

"This classification has several features which make it advantageous for general use. The different parts of a mill can be designated with no reasonable chance of a misunderstanding, while with the usual method of referring to mills, this is not the case, for the terms 'side,' 'face,' or 'end,' are applied indiscriminately, and there is no common agreement on these terms among mechanics. The same term under the proposed classification is never applied to two different parts, and the mills are arranged in four definite classes, according to the work which they perform."

At Fig. 6 is given an example of milling machine work, selected from a number given in the book, this being the frame of a box tool used in the turret head screw machine, and is typical of a large class of work which is specially adapted to be done on the milling machine, and can be done there better and in much shorter time than in any other way. The arcs of circles upon the different faces of the work show very clearly the character of the cuts taken.

Cam Motions.

BY A. D. PENTZ.

The peculiarities of the particular kind of cam to be considered can best be described by reference to that form of it shown in Fig. 1.

It will be seen that there is a shaft carrying a flange, and on that flange there is a roller set a considerable distance from the center of the shaft. This roller fits the slot in the cam so that it may move freely, but have no lost motion.

When the flange revolves in the direction of the arrow, the slide to which the cam is attached will reciprocate, and its motion will be modified by the shape of the slot within which the roller travels. The shape of the slot here is an arc struck from the center *C*.

The effect of a cam in which a roller operates within a slot of irregular shape is not calculated from either side, but by the central line between the two sides. This will not affect the cam in Fig. 1, because both sides and the central line are struck from a common center, as *C*. In fact, this particular cam gives precisely the same motion as would be produced if the cam were removed entirely, and the center *C* were on a stud attached to the slide *F*, and this stud were connected to the roller by a link or connecting rod of a length equal to the distance from the center *C* to the center of roller.

In a slot of one arc, as here shown, or in a straight slot, as indicated by the dotted lines *A D* and *B E*, a block, as *G*, may be employed instead of the roller. But, however preferable such block may be theoretically, it is found in practice to be quite inferior to the roller shown; in respect of friction, economy, and lasting quality.

Instead of an arc, if the cam in Fig. 1 was of a shape as the straight dotted lines *A D* and *B E*, the reciprocating motion of the slide would be in exactly the same time at one end of such motion as at the other. With the arc shown, however, the motion is much accelerated when the roller passes to the right of the center line *a b* of the shaft toward and from the center *C*, and, of course, is correspondingly reduced during the other half revolution.

In Fig. 2 this cam is shown as operating a hinged lever.

The acting part of the cam is made from three arcs, *H A*, *A B* and *B G*. The arc *A B* when occupied by the roller, as in Fig. 2, coincides with the path in which the roller moves, so that, while the roller is moving from *A* to *B*, the lever will be at rest. But it will be at rest only once in each revolution of the flange. It is practical to make this rest equal one-sixth of the time of revolution, and have no noise. The rest *A B* is as practical in a cam in the slide, Fig. 1, as it is in the lever, Fig. 2.

If a straight slot were made in this lever, the center line of which is indicated by the line *I K*, the rate of movement would be greater when the roller passed between the shaft and the fulcrum, and less when it should pass on that side of the shaft opposite the fulcrum. The lever would be reversed at the moment the roller reached the arc *C D*, whose center is the fulcrum *K*, and the difference in the time of each sequent oscillation would vary as the distance between this arc and the line *E F*. This difference must be considered in the design of cams.

Fig. 3 illustrates the needle bar cam of a sewing machine. This is the most practical form this style of cam has taken. There have been probably twenty millions of such cams made and used in different kinds of sewing machines, and, after many attempts to get a satisfactory equivalent for this device, it is the most effective thing for the purpose yet found.

The peculiar thing about this cam is that it receives more motion than the throw of the roller gives it. It will be seen that a roller traveling as indicated by the arrow will have forced this cam down to the extreme when it has reached the point *A*. Then to reach *B* the cam must be raised so as to bring the roller arc indicated by the arrow to the middle of the slot beneath *B*. Again to reach *C* it must be returned to the lower position. Thus it is possible with this cam to strike two blows at one end of a stroke, and, if required, one of them may be thrust further than the other. This is called "second motion."

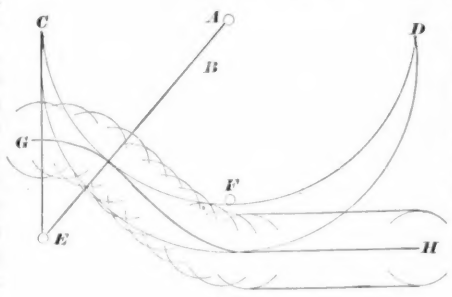


Fig. 5.

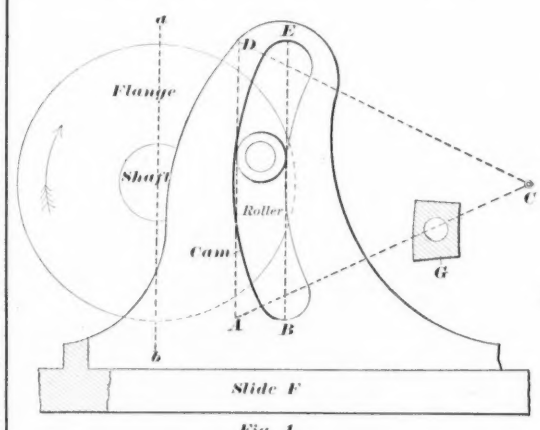


Fig. 1.

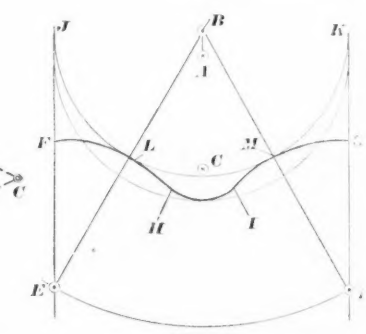


Fig. 4.

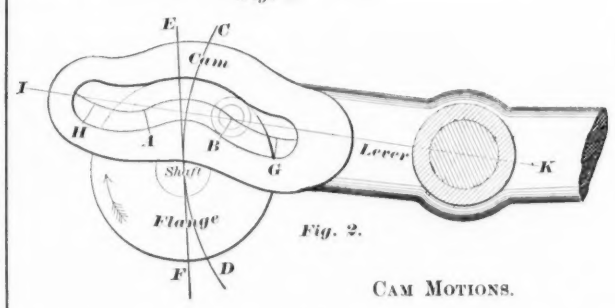


Fig. 2.

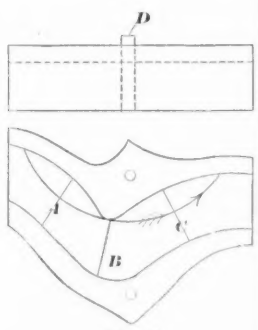


Fig. 3.

CAM MOTIONS.

To design a cam having two motions at one end of the stroke, as in Fig. 4, indicate the centers *A* and *B* a distance apart equal to the required short second motion. Then with a radius equal to that of the roller on the flange, describe the crescent *J K* from these centers. On the inner arc of the crescent indicate the time or degrees of rotation *L* and *M* to be consumed in making this second motion, and through *L* and *M* draw the lines *B E* and *B D*. Then draw the lines *J E* and *K D* from each end of the crescent parallel to each other, and to the line between the centers *A* and *B*. Draw the arcs *F H* and *I G* from the intersections *E* and *D* as centers. The center *C* will have to be obtained experimentally, and must have a position that will give the arc *H I*, touching the outer arc of the crescent, and joining smoothly both arcs *F H* and *I G*.

This rule cannot be taken to construct all such cams, but it will indicate the main features of them all. This crescent, however, will be found of advantage in almost every cam of this character where the amount of second motion and the time used in making it must be accurate.

In Fig. 4 only the center line is given. In Fig. 5 is shown a cam which has more motion than the throw of the roller, but no second motion. This is of advantage where the room is limited sidewise. The usual method of getting two lines parallel to the central *G H* is indicated.

It is always to be preferred that the places in cams of this character where the roller reverses its motion within the cam, and begins to return over its track, should be at right angles to the movement of the cam, or nearly so. If not, there is likely to be noise.

All the cams here given are as applicable to a lever as to a sliding device. In designing a central line for this kind of cam, no curve must be made that has a radius as short as half the diameter of the roller to be used in it. If a radius be so short, an angle will be found at the exact point the center has occupied. If the radius be shorter there will be a loose place at the point the center occupied which nothing can cure. Have the radii as long as practicable.

I have known a roller in a cam similar to Fig. 3 to maintain a speed of more than three thousand inches per minute. The cam, roller and roller stud were hardened. This duty was not continuous, but stopped about eight minutes in each hour. The work done was to reciprocate a bar, which, complete, weighed perhaps three ounces, a distance vertically of about one and one-tenth inches and about nine hundred times per minute. In addition to this it perforated layers of hard linen cloth one-sixteenth of an inch thick, with a needle more than two one-hundredths of an inch in diameter.

At the end of three months wear of this kind the cam was found to be in good order. The roller was slightly worn, but the roller stud was most worn, being oval and about two-thousandths of an inch smaller in one direction than it was originally.

These cams are now usually made of machinery steel for sewing machines, and case-hardened. In some instances the groove is partly drop-forged into them, but in others the blank is punched from the flat stock, and the groove is milled from the solid. Everything considered, perhaps this latter plan is the better one. In which case the preferable procedure is like this:

Make the die .01" larger than finished model, groove side up. Pickle the scale off the stock, and anneal it before punching. Flatten in drop press, groove or punch side down.

Make a punching die to exact model size and re-punch the blanks, groove side down. This reverses the punching operation, and will, if done well, make the edges equal to a mill cut, and quite square on both sides.

The groove side will require no milling if the flattening is good, but it should be lapped so that the burrs, etc., may be taken off, as that side is down in the next operation, that of milling the back or the seat on which it is attached to its bar.

In the cam shown in Fig. 3 the position on the bar is got by the projection *D*. The top of this will not ordinarily be required to be milled, because the groove may be cut deep enough to accommodate every reasonable variation in this height. Therefore there need be but two cutters in the gang to mill this seat as shown; but if there be other shapes added to it other cutters may be required.

The groove now only remains to be milled, which is admirably done by machines made by a number of first-class makers.

Just here I wish to say a word about the "burring" of steel after it is milled, and all I have to say is that such burring and cornering generally costs more than the milling operation that precedes it. It is all hand-work of a tedious kind, requiring care and judgment. Perhaps some genius can see a way to do this work by tools.

Fast Railroad Trains.

London *Engineer*, in commenting on the performance of the fast train on the New York Central road, says: Taking the American run as a whole, it constitutes a distinct departure in railway work. Not the least remarkable feature about it is that it shows that it is possible to attain very high speeds with comparatively small coupled wheels. It by no means follows, however, that it is advisable to retain them for very fast trains. On the other hand, we believe that very high wheels are equally out of place if very long runs are to be made, because on such runs it is certain that more or less steep inclines will have to be surmounted. If the average speed of a train is to be about fifty to fifty-five miles an hour, then banks may be ascended at forty miles an hour, or even less, and descended at sixty to sixty-five miles an hour.

But when an average speed of sixty miles an hour must be made, we cannot rely on descents to compensate for ascents, because enormous velocities would be required, and the cost and wear and tear would be out of all proportion to the advantage gained. The engine must, therefore, be competent to maintain a high speed when running up hill, and this is almost impossible if very high wheels are used, unless the cylinders are too large for the rest of the road.

As these high-speed long-distance trains cannot be heavy, it appears to us that the best type of engine would be one with 18 inches cylinders, 26 inches stroke, 1,400 square feet of heating surface, 20 square feet of grate, and single drivers carrying about 18 tons, and 6 feet 8 inches in diameter, provided with the sand blast. Such an engine would be an admirable hill climber, and would run about as fast as any locomotive made. When the runs are over comparatively level roads, then a big wheel, such as Mr. Stirling proposes, is no doubt good, because its use reduces wear and tear.

Whether any extremely fast running will be done in this country remains to be seen. Any speed that can be attained in the United States can, of course, be got here on our better roads. But it is more than questionable that these excessive speeds pay. Whether they do or not is really the whole question. The problem is not one for the locomotive superintendent, but for the general manager.

The writer of this had occasion to pass down the elevated road from Jersey City Heights to Hoboken recently, at the early time in the morning when mechanics are going to their work. By actual count there were sixty-two men in the car, and all but three were reading their morning paper. He never saw so large a proportion of business men reading on a train.

A Cast-iron Pedestal Forge.

The accompanying illustration shows a cast iron pedestal forge, which was designed in 1884 for the then new Laboratory of Practical Mechanics, Purdue University. Twelve such forges constituted the original equipment, which has since been doubled, and forges have been supplied to the laboratories of other institutions, until more than fifty are now in daily use.

When in service the bowl about the tuyere, and the pan above it, as shown by the section, are filled with cinders to the upper level of the forge. This heavy cinder filling keeps the inclosing iron parts cool at all times. This forge has proved to be very convenient, and while it is designed for light work, the fire is always deep, and may readily be made quite heavy. A room equipped with these forges may easily be made to present a clean and otherwise attractive appearance. The surface of the forge is 31 inches above the floor, and the top of the tuyere 6 inches lower. The diameter of the upper pan is 32 inches, and the tanks are 7 by 19 by 8 inches deep.

At the time the first lot, already referred to, was made, there was no similar forge on the market, and it is believed the general form, herein presented, originated with the design of this forge. The design is by Prof. W. F. M. Goss, Purdue University, La Fayette, Indiana.

A CAST-IRON PEDESTAL FORGE.

A New Shingle Machine.

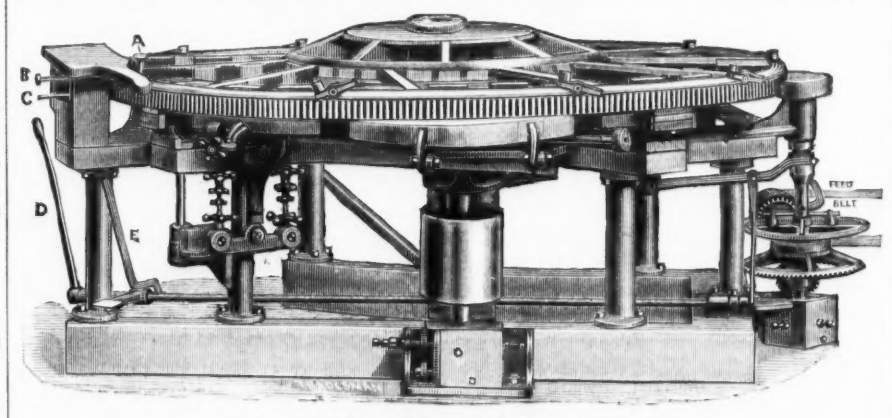
We present herewith an illustration of a new machine for sawing shingles, made by Perkins & Company, of Grand Rapids, Mich.

It is a rotary machine, in which the blocks from which the shingles are sawed are secured in carriages which are moved in a circular path by means of the large gear wheel shown, encountering at each revolution about the machine two saws, which are placed on the vertical arbors shown, so that two shingles are sawn from each block at each revolution. The saws are not placed diametrically opposite each other, as is usually the case, but are so set that one saw has completed its cut about the time the other saw is commencing to cut, and thus the strain on the machine and belts is considerably reduced, besides securing a much smoother and more regular action.

Special devices are provided by which the carriages are automatically tilted at the proper time, and the blocks can be readily set in accordance with the grain, without in the least interfering with the tilting arrangement.

An adjustment is provided by which the saws are readily brought into the same plane, and all other necessary adjustments are provided in the most convenient form.

Special provisions are made for disposing of sawdust and spalts. There are nine different rates of feed, each varying from the other by 10 clips per minute, or $\frac{1}{16}''$ of feed per revolution of saw. Thus, setting the minimum feed at 110 clips, the maximum will be 210 clips. This machine is yet too new to have established a record, but it is expected that the previous records of 214,000 shingles per day for an entire season (Michigan Shingle Company's mill, Muskegon), and of 286,000 shingles in a single day (Buckley & Douglas, Manistee), made on machines built by this company, will be considerably surpassed.



A NEW SHINGLE MACHINE.

Springs and Weights.

BY J. MCKIM CHASE.

In No. 47 of the current volume of the AMERICAN MACHINIST, Mr. W. H. Booth, with his usual correctness, discusses the relative value of springs and weights in certain applications to machines.

Designers will agree with him generally in his conclusions that springs are preferable where the object is to be suddenly put in motion, and the motion suddenly arrested. In a recent personal experience, where the above requirements prevailed, the object was accomplished through the medium of a spring where numerous other devices failed.

In such instances it is the effect of inertia, or that resistance a body offers to being put in motion, that is sought to be circumvented.

While in some cases in the economical movement of bodies inertia is a detriment, and is sought to be avoided, in others its effect is of the utmost importance, and a valuable aid.

A large experience in the manufacture of screw propellers of various kinds, and observation of their practical performance some years ago, led me to entertain views then at variance with the prevailing practice and the generally received opinion of the theory of their operation. I advocated smaller diameters, greater pitches, and higher rotative velocities. Few of those eminent in the profession of steam engineering agreed with my views, because Rankine, to whom the profession is so much indebted, and who was regarded as its highest authority, had enunciated that a vessel is made to move forward by the propelling instrument moving a mass of water in the opposite direction, and the larger the mass and the slower its velocity the more efficient becomes the propeller—which is all correct, because the energy required to move a body increases with the square of its velocity. A lighter body moving at a high velocity may absorb more energy than a heavier one moving at less velocity, although the amount of work done may be the same in both cases.

Froude was also quoted as saying that a fine pitch screw gives a squarer action or push.

Notwithstanding both of these authorities were correct, and the former's opinion is predicated on the laws of moving bodies, those who have watched the progress of marine engineering must have noticed for some years a constant tendency in the direction I have outlined.

In seeking for the cause of the greater efficiency of the smaller screws moving at higher velocities, I concluded the benefit arose from the resistance the water offered to being started from a state of rest, its inertia. It is well known that it requires more force to start a body moving from a state of rest than it does to keep it moving afterwards.

A familiar instance of the effect of inertia of water is seen in the ricochetting of a shot fired over the water. As no two bodies can occupy the same space at the same time, a volume of water equal to that of the shot must be displaced before the shot can penetrate the water. Now it requires time for this displacement, and before it can be displaced with the velocity at which the shot is moving, it offers sufficient resistance to deflect the shot; this ricochetting is repeated every time the shot comes in contact with the water, until it has lost sufficient velocity to enable the water to be displaced, when the shot will penetrate. With a shot fired over the water, the resistance offered when it strikes causes it to be deflected in the path of least resistance; but when it is fired submerged it meets with successive masses of water at rest, and the resistance encountered confines the shot to small range.

A plane presenting angle—not a right angle—to the line of motion when moved through the water will have a tendency to move in the direction the plane occupies, and this tendency will vary according to the velocity with which the plane is moved, or the time allowed for the water to become displaced. If the velocity is such as to allow the water to fall in behind as fast as it is displaced in front, then the pressure on the two sides will be equalized, and there will be little tendency to move in the direction of the plane, because the resistance would be chiefly that arising from the friction of the particles of water on the surface of the plane; skin friction, the inertia of the water, would be small at such velocities.

In a perfect fluid, there being no viscosity to overcome, it is said there is no resistance encountered by a body moving through it when the velocity is such as to allow the fluid to flow in natural streams, and an equalization of pressure preserved on the body. The tendency of the plane to move in its direction depends on the resistance it encounters in displacing the water, and the resistance will vary according to the plane's velocity and condition of the water. If a helix be substituted for the plane, and rotated on an axis, and all other movement than that of rotation prevented, as with a vessel made fast, the instrument becomes, as Chief Engineer Lowe remarks, simply a pump. The water flows in at one end by its natural motion, and is discharged at the other. But this action is quite different from that when the vessel is allowed to progress.

When made fast, the screw acts on water already put in motion by gravity, and in a direction in which it is displaced; but when the vessel is allowed to progress the screw meets with successive masses of water at rest, and the resistance it offers to being put in motion produces a greater tendency to move in the direction of the axis of the helix.

The foregoing views have been confirmed by the results of experiments with aeroplanes made by Messrs. Langly and Maxim, wherein they learned that the higher the velocity the planes were moved through the air, the greater the weight they would support per unit of propelling force, which phenomenon Mr. Maxim correctly ascribes to the planes meeting with successive masses of air at rest.

After the planes had revolved for some time, and the air in the circle of their revolution attained a downward movement, then the effect was not so marked as before.

It is this factor of inertia, and the difficulty of approximating its extent under all conditions, that has made the subject of marine propulsion such a complex problem, and has baffled so many who thought they knew all about it. It is this that will enable the screw to maintain its supremacy as a propelling instrument, and make difficult the economical application of the jet principle.

Piece-work, Overtime, Technical Schools.

BY W. H. BOOTH.

Much has been written now concerning piece-work from the worker's point of view. This, of course, always embodies more or less of the assumption that the employer is a sort of extra terrestrial fiend, constantly on the alert to seize opportunities for reducing wages and piece prices.

To some extent this is the case; for in any line of business the liberal employer is more or less circumscribed in his liberty by the actions of his less liberal competitors, and so feels obliged to do many things which are contrary to his wishes, and even absolutely distasteful to him. He is between two fires, and must either shut down or follow suit at a more or less close distance of his competitors.

To an employer of this stamp life is not all "beer and skittles," and too often he is treated by his men no better than the man who takes delight in cutting prices.

All employers are by no means the ruffians they are represented to be by too many of the workers' leaders.

On the question of piece-work there is, therefore, much to be said on the employer's side.

Granted that a man who works by the piece ought fairly to be able to earn by an attentive day's work from 20 to 50 per cent. more than he does by day-work, it cannot be fair that any man on piece-work should even be able to turn out three or four times the work he was previously doing by the day. It is such instances as this that have been seized by employers as their excuse for rigid cutting down of prices, until they have gone as far one way as the men had been going in the other.

Doubtless all of us have met with workmen who push along work, even miles away from headquarters, and under no oversight, whilst others similarly let time drift as it may.

There is at present a strike on hand in the north of England, in the engineering works, against overtime. The men do not object to all overtime, but think it ought to be kept as low as possible. The employers largely agree, but object to the question of whether certain work shall be allowed overtime being left for the trades' union officials to decide.

Now it seems to me that the employers ought to be glad to have a chance of stopping overtime, and take the risk of an occasional decision against it for the sake of the saving effected.

In many cases—far too many—overtime is simply the worker's excuse for spending an hour over his tea instead of thirty minutes; for a good supper at 11 P. M., for which he is paid 1½ hours' time, at least, to eat; for a two hours' nap in the small hours which he is paid for at three to four hours' of time, and the work done is small indeed. Other men when out in charge of work look on the whole affair as a means of recreation, leaving their duties to the

second man, and evincing ingenuity only in their skill in so arranging work that overtime will be necessary, such overtime being arranged so that the proper train homewards is missed, and then the two hours of waiting for the next one are spent in a cosy corner, and paid for, of course, as time traveling home.

As here and there an odd employer will spoil the comfort of a dozen shops, so an odd worker of the above type spoils things for the better disposed, and they are always so plausible, too, that it is quite difficult to bring things home to them, and they can always contrive some means of bringing matters round to suit their own plans. Overtime ought to be of very exceptional occurrence, and closely looked after, or it degenerates into a farce.

This is, perhaps, less marked in the shops, but even there it is impossible to get efficient work in half-lighted corners. Where overtime gives perhaps its best return is on the running of a lathe or shaper, or a boring-mill for pushing on repair work. The foreman sees a cylinder started to be bored out at 5 P. M., and by 7 A. M. next morning he sees so much of actual work done, and if it is not done he knows there has been neglect, and perhaps stoppage, and will have cause for complaint, especially if there is a tell-tale ridge left behind.

Quite apart from willful shirking, no man can do his naturally best work when overfatigued; and if nine hours be a proper day's work it is uneconomical to do more, and if two or three hours' overtime daily can be properly worked, why the call for shorter hours?

When an apprentice—and I had to do as I was told—I have worked half a week without sleep, and frequent long stretches of twenty-four hours on and twelve off, and I would to-day gladly give back tenfold the earnings of that overtime to be able to undo it and its lasting physical effects. I have seen some men work until they could hardly stand, and I have seen others doze away hours they were paid for; and my conviction is against overtime, though there are times when it may very fairly be required, and the men ought not to refuse it—on such occasions as will sometimes happen where perhaps another thousand workers are idle through the breakage of a crank-shaft or the splitting of a cylinder.

The quarreling over piece-work and overtime is not therefore wholly debitable to employers; the employed are often in fault, and are too much inclined to overlook the fact that shops are run with the intention of making a profit, and a shop that makes no profit usually ends sooner or later in closing. So long as the present social conditions hold good this question of profit-making has to be faced and recognized, and it is manifestly foolish to strike for increase of pay in face of a big contract taken on an assumption that a certain wage cost will be incurred thereon, as this probably means that no other such contracts will be heartily sought for, and that shop will be less busy, and men will be paid off, and have to break up their homes, and find fresh settlements,

On the whole, at the present time in this country [England] wages are good all round, and though some people are starving, and others taking their own lives for want of employment, there is a call for workers in many directions, and good wages are waiting for thousands who refuse them, because poor wages are to be had in overcrowded but "genteel" occupations.

There is room for really skilled and dependable workmen in many branches of trade—workmen of the old type of long apprenticeship days, not college-bred half workers. I confess to a feeling of utter despondency when the young college or technical school youth comes and shows me a roll of drawings. These precious rolls usually contain some pedestal, or plummer block, as they are termed, or an impossible engine cylinder. I do not think engineering can be usefully taught in a school or college. Its principles may be taught, and double the mathematics necessary for nine out of ten engineers may be picked up, but the means of applying either of these cannot be taught, but must be picked up by the student himself when he gets amongst practical work.

If he is taught in a college to design a pump, for example, he will get drilled into him the customary 25 per cent. allowance for slip, and yet when he gets into practice he may discover that sometimes a pump will deliver more water than its speed, stroke and area can be figured upon to do, and he will learn not to trust to calculation of a pump's duty when he is on certain special work. He will find fifty conditions to be attended to in boiler making if he makes a specialty of this subject, besides the ring tension over which he worried as the one thing needful.

There are some things a college, properly equipped, can teach, which may be named:

A college with a good steam engine, fitted with dynamometer, brakes, indicators, and all necessary instruments can teach a student who has acquired the necessary knowledge of physics how to make a thorough steam engine test, and the knowledge will stand good to him in practice, unless he is so perfect a fool that he cannot devise means of rigging up the necessary arrangements on every type of engine he may be called on to test, for the reason that it is taught practically as applied, but probably to greater refinement than actual practice will demand. Where there is a *bona fide* intention to make a genuine steam engine test in practice, one man can do the work of half a dozen men on such tests as are so often published in some technical papers, results teeming with figures to three decimals, and yet with something omitted that really vitiates the whole as an exact scientific determination.

Some little time ago an engine made by a certain firm was tested, and the results were marvelous. A new engine by this same firm was shown me lately, using four times the fuel it was guaranteed to do. One hardly ever sees a test published which carries a really genuine face on it. There are allowances made for this, and deductions for the other, which may be well enough, but do not carry conviction to the critical outsider. It would appear better, where publicity is sought, to state actual facts, and, if any allowance is fairly due on any item, to state this as a conclusion, and say that, if allowed, it would alter certain of the results by so much per cent. Unfortunately, too many professors of engineering get so far off the beaten track of practice that they teach obsolete practice rather than incur the odium of merely teaching theory; and yet there is little doubt that the latter is the more valuable in a college course as a groundwork for the student to utilize in practice. If a man has so little of the engineer about him that he cannot soon learn to apply theory to practice, and form a working connection between them, it is doubtful if such a one should ever have received a college course at all.

It is very doubtful if the use of machine tools is at all needful for an engineering course. A man who can turn and bore and mill articles of metal to exact dimensions and fits may be an excellent machinist; he is by no means of necessity a mechanic, and still less can he claim to be an engineer. True, he may be all three of these; but skill as a handicraftsman is no proof of engineering ability, which is often curiously exemplified in shop foremen who are apt enough at work, and yet quite unable to design anything original.

I am informed, however, that at the various schools up and down England—I refer to the somewhat novel technical schools—much good is being done, but I also learn that the students—or at least a large number of them—are engaged during the day in actual work, and attend the schools in the evening. Though this may seem to make a long day's work, it is probably the best course to pursue; for undoubtedly those engaged during the day on practical work will soon learn to strike a balance between practice and mere theory, and will largely assist to help their fellow students to a knowledge of many things in practice which do not follow the school methods. The teachers or professors in such schools must undoubtedly be largely helped by their pupils to keep in line with practice, and point out applications of theory. When carried on upon some such basis as this, the school is far better calculated to achieve success than when a mere "college," teaching youths who have no means of comparing what they hear with what they will later be called on to do.

Good Work and Good Ways of Doing It.

BY A MECHANIC.

When I tell of a way of doing work, I hope I shall not be understood to say *the way* to do it, for this is not what I mean, but instead, to tell of ways that may be useful to many at some time, to fit a certain set of conditions. In this I try to show a good way to bore two or more holes in a disk, equally distant from a central hole, and equally spaced.

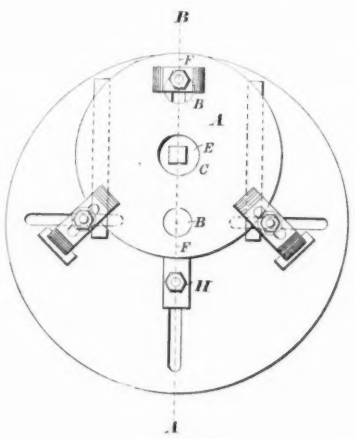


Fig. 1.

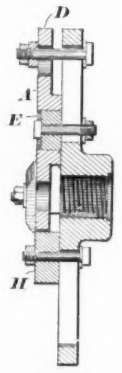


Fig. 2.

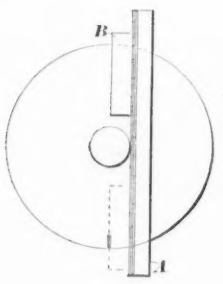


Fig. 3.

GOOD WORK AND GOOD WAYS OF DOING IT.

Of course the accuracy of most any method depends much upon the skill of the person who does the work. When we have skillful workmanship and good methods, we then are about sure of good results.

In Figs. 1 and 2 I show the disk *A* mounted upon a lathe face-plate for the purpose of boring the holes *B B* equally distant from the central hole *C*, and correctly opposite each other. Now what would we call *correctly opposite?* If I knew this disk was only for a washer or strap, for three bolts to fetch up upon, for strengthening a brick wall; and what I would call correctly opposite, when I knew the disk was wanted for a purpose where accuracy is required, would be two different kinds of opposites altogether. If I had a strap to make with three holes for the brick wall, I would consider a good way would be to take a common wooden rule and a piece of chalk, a big center punch and hammer for fine tools, and a drill press for the machine tool. I would consider, if I got the holes laid out within $\frac{1}{16}''$ or more of what the drawing called for, and then if I drilled within $\frac{1}{16}''$ or more of where it was laid out, that it was accurate for the purpose. We will suppose that the disk *A* is for a jig for reaming similar disks which are intended to interchange over three studs, which closely fill the holes, and that these studs are now located to the dimensions given me to work from.

Now this job is entirely different from the "brick wall strap," although the drawing may look just the same, which is a point that some so-called mechanical engineers would do well to bestow a few moments thought upon sometimes. Of course there is more than one way to do this, but I shall trouble you with only one this time. I bore the central hole, and turn the disk on an arbor in the usual way, squaring it true on the back side *D*. I bolt the hub *E* (which closely fits the central hole) to the face-plate as shown, setting it the right distance from the center by making it run out of true twice the amount it is wanted to be off center, as explained by me in the AMERICAN MACHINIST of Oct 1st.

I draw two lines on face of disk, as shown at *F F*.

The accuracy of the spacing depends upon these lines being right, so if it is convenient to locate these lines from a good index plate it might save time. For some jobs it would be near enough to index from the large gear on lathe spindle, if no such way is available, we are obliged to adopt a hand method. In Fig. 3 is shown a way.

Suppose the central hole is two inches in diameter; I use an arbor or plug to fit, and a straight-edge to extend across disk, and in contact with plug, as shown. I then take another straight-edge or parallel with sharp corners, one inch wide, to extend to the center, as shown. I hold the straight-edge firm across disk, and draw a line outside the parallel *B*, and then change the parallel to the other side of disk, as shown in dotted lines, and draw another line; these two lines are not just central, for these lines are, of course, drawn entirely outside the parallel. I then change the straight-edge to the other side of plug, and set it so that the parallel, when used as before, will just hide the two lines made first, then draw two more lines in the same way; the spaces between these lines are the correct center lines.

I now put the disk on the face-plate, as shown in Fig. 1, and bore the first hole most anywhere; the bearing *E*, of course, insures the distance from the center being correct.

After boring the first hole, and before moving it, I bolt the piece *H* to the face-plate, as shown, and draw a line upon it to match the line *F* upon the disk; I can then turn the disk around on its stud till the opposite line corresponds with line on piece *H*, when it is in the correct position to bore the other hole. It will be seen that this method will answer for boring any number of holes or any kind of spacing, only depending upon first getting the lines in the right places.

In boring a large disk where the holes are near the center, it will be seen that a slight error in making or setting to the lines will be reduced at the holes.

LETTERS FROM PRACTICAL MEN.

Proportions of Keys—A Correction.

Editor American Machinist:

In your issue of December 3d the resumé of the proceedings of the American Society of Mechanical Engineers seems to have been very carelessly reported, and what the writer is therein made to say is no less than absurd.

"Another member" (the writer) is quoted as saying: that "a key flatted on the shaft, without being laid into the shaft at all, will hold better and do more severe work than a key that is let in one-quarter the depth of the shaft. I would think myself, in all ordinary cases, where the work was severe particularly, I would have the key less than one-third the diameter of the hole for the width."

What I did say was: "A key having a width equal to one-third the diameter of the hole, flatted on the shaft without being let into the shaft at all, will hold better and do more severe work than one having a width equal to one-quarter the diameter of the hole, and let into the shaft one-ninth the diameter of the hole; and that if a standard were to be adopted my own choice would be for all ordinary cases, and particularly where

the work was severe, to adopt not less than one-third the diameter of the hole for the width of the key." JOHN T. HAWKINS.

[We are glad to receive this communication from Mr. Hawkins, enabling us to give to our readers an explanation of some things that seemed somewhat mysterious in the report, which, however, we may say, was made by one of the most expert stenographers on technical work in this city, and edited as carefully as the ordinary exigencies of editorial work seemed to allow. We do not, of course, expect always to avoid mistakes, but expect that, when we do make them, some of our readers will, as in this instance, correct us. This may be an appropriate time to say that the loose custom which prevails to some extent at the meetings, regarding the recognition of members by the presiding officer, is in many cases specially annoying to members, and very much increases the difficulty of making accurate reports. In many cases the names of members are not announced at all, and in others it is so indistinctly done that it is impossible to recognize it. Some of the members simply rise and commence talking without waiting for the formal recognition by the chair which the rules of all deliberative assemblies require. In some cases this may result from the fact that the president is unacquainted with the members; but where this is the case the member about to speak should himself announce his name to the chair and then wait for formal recognition before proceeding to speak.—ED.]

The Slide Rule.

Editor American Machinist:

The number of responses I have received through my article on the Slide Rule, in your issue of October 29th, conclusively prove two things—the wide circulation of the AMERICAN MACHINIST, and the interest that exists in regard to the use of the slide rule. I am in receipt of communications ranging from the St. Lawrence to the Gulf and Rockies, and also from points in Canada, and yet they come. At the time of penning my first article I had little thought I was touching on a popular theme, though I felt it should be such; I cannot but think that Mr. Coleman Sellers' earnest lines on the subject must have had the same readers as mine. Both by direct question and by inference the letters ask, How can we get a clear understanding of your apparatus? I reply that all slide rules require that the user should be able to arrange the questions presented to him so as to have three known quantities (symbolized by *a*, *b*, *c*) by which to find the fourth quantity (*x*); this action of the mind comes into operation when figured calculations are to be made, therefore the operator is not called upon to perform a novel action, so far as that goes; the novelty is that he is required to apply those quantities to a scale, and to read the answers off in accordance with a simple and easily learned rule; this rule I gave in my article of October 29th, and space does not allow of its repetition. In illustration of its application some problems will now be presented, with their arguments, settings and readings.

Problem: What is the interest on $942 for 16 days—the year being 365 days—at 7¾ per cent. per annum?

First Argument: If 365 days (one year) will yield $7.75 (on $100), how much will 16 days yield? Therefore, as 365 (*a*) is to 7.75 (*b*), so is 16 (*c*) to proportionate interest (*x*); this gives three known quantities by which the fourth is to be found.

First Setting and Reading: Look for 365 (*a*) on the inner scale, then bring in line with it 7.75 (*b*) on the outer scale; now look for 16 (*c*) on the inner scale, when in line with it on the outer scale will be found 34 nearly, (*x*) to be read as 34 cents.

Second Argument: If $100 will earn 34 cents, how much will $942 earn? Here there are also three known quantities.

Second Setting and Reading: Look for 100 (*a*) on the inner scale, then bring in line with it 34 (*b*) on the outer scale; now look for 942 (*c*) on the inner scale, when in line with it on the outer scale will be found 320; (*x*) to be read as $3.20. While the explanation requires a number of words, such a problem can be solved in thirty seconds by an average worker. The foregoing is a commercial problem; I will further illustrate by giving a mechanical problem. What is the nominal H. P. of an engine having an 8-inch cylinder, with an average steam pressure of 45 pounds, and a piston speed of 300 feet per minute?

First Argument: To find the square of the cylinder diameter—which is 8 inches—it is necessary to multiply 8 by 8; therefore if 1 (*a*) will produce 8 (*b*), how much will 8 (*c*) produce (*x*)?

First Setting and Reading: Bring 1 on the inner scale in line with 8 on the outer scale; when in line with 8 on the inner scale will be found 64 on the outer scale; read as 64 inches.

Second Argument: This gives the contents of a square with sides of 8 inches; it is necessary to reduce that to the area of an inscribed circle, which is found by multiplying the square area by decimal .7854.

Second Setting and Reading: Bring 1 (*a*) on the inner scale in line with 7,854 (*b*) on the outer scale; when in line with 64 (*c*) on the inner scale will be found 5,027 (*x*) on the outer scale; to be read as 50.27 inches.

Third Argument: The total pressure can now be obtained; for as 1 inch (*a*) is to 45 pounds (*b*), so are 50.27 inches (*c*) to the circular area (*x*).

Third Setting and Reading: Bring 1 on the inner scale in line with 45 on the outer scale; when in line with 5,027 on the inner scale will be found 2,262 on the outer scale; to be read as 2,262 pounds.

Fourth Argument: The sum of the pressures is now to be found, which is as 1 foot of travel (*a*) is to 2,262 pounds (*b*), so are 300 feet (*c*) to sum of pressures (*x*).

Fourth Setting and Reading: Bring 1 on the inner scale in line with 2,262 on the outer scale; when in line with 300 on the inner scale will be found 679,000 nearly; to be read as 679,000 pounds.

Fifth Argument: To reduce this to H. P. it must be divided by 33,000; therefore as 33,000 pounds (*a*) is to 1 H. P. (*b*), so are 679,000 pounds (*c*) to the nominal H. P. (*x*.)

Fifth Setting and Reading: Bring 33,000 on the inner scale in line with 1 on the outer scale; when in line with 679,000 on the inner scale will be found 2,050 on the outer scale; to be read as 20.5 H. P.

Though there are several arguments in the foregoing, the solution by slide rule would be procured in from 1½ to 2 minutes. A very valuable feature that is solely inherent in the disk form of slide rule—of which the proportor is an example—is, that it gives continuous readings based on an initial ratio, that is to say, while the ratio *a* : *b* is the first antecedent (*a*), and the first consequent (*b*), there are a series of second antecedents and second consequents, such as : : *c* : *x*, : : *d* : *x*, : : *e* : *x*, and so on. The setting in such case being: Bring *a* on the one scale in line with *b* on the other scale, then on the same scale as *a* is on look for *c*, *d*, *e*; when in line with each on the same scale as *b* is on will be found each respective *x*; thus but one setting is required to extended numbers of second antecedents with their consequents; in practice all antecedents and consequents after the first of each are second.

As the whole range of commercial and mechanical arithmetic is within the compass of the principles underlying the slide rule, the "proportior" has been constructed so that solutions are rendered easily and rapidly. It can be said of a surety, that an efficient operator on the slide rule would as soon return to figuring as he would exchange his watch for a sun dial to depend for his time on it. The study of the slide rule will amply repay the time given to it, while the boy entering life will find himself better equipped, if he carries with him the ability to use it. WALTER HART.

114 Liberty St., N. Y.

About Steel.

Editor American Machinist:

Under the heading, "An Interesting Experiment with Steel," in your issue of Nov. 12th, are some statements which, in my "rule of thumb" way of treating the steel question, I wish to hold up to the light, that is, to such light as the plain, practical steel worker can comprehend. That steel is such in consequence simply of a "combination of iron and carbon," is not, or need not be "the universal idea."

Steel may be as truly steel with practically no carbon combined, as though it had combined the highest percentage possible. The question, What constitutes steel, as distinguished from iron, is not to be settled simply by the presence or absence of carbon. Steel may be adjudged to be iron, because heating to hardening heat and suddenly cooling utterly fails to harden it. Iron may be called steel simply because it does harden readily under the same treatment to which hardening steel responds, and still the soft, nearly carbonless steel, is just as truly steel, and the hard, highly carbonized iron is just as truly iron as though the test of hardening had shown what might be expected.

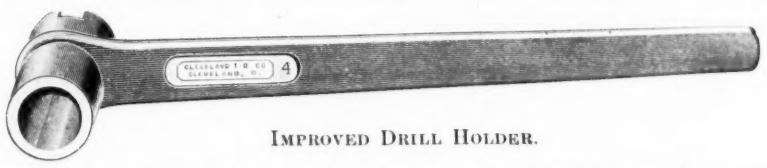
It is a question of structure, not a question of carbon.

For certain uses, it is necessary or desirable, to say the least, that steel should contain certain percentages of carbon, the exactly right amount naturally insuring, under proper conditions and treatment, the best results; but that "two per cent. of carbon" exists in "steel wire nails" and "iron cut nails" must strike those who had supposed that something was known of the make-up of steel and iron in the light of a new discovery. Two per cent.! What can be meant? That would be too high for tool steel. More than twice as high as the average of tool steel in general use. There! having fired a shot at what looked so queer to me, I will proceed to deal with that part of the letter which treats upon changes resulting from heating.

"When steel is heated, the atoms of carbon have a tendency to unite, and form comparatively large particles; when slowly cooled these particles remain large, but on being chilled the molten particles are shattered to atoms; in this way the surface area of diamond presented to iron may easily be increased from ten to one hundred times. With this increased surface, contact, and the more thorough diffusion, it is not difficult to understand why steel should harden on being chilled."

I believe the above to be accurately quoted. Now, as statement of facts, in my judgment, the judgment based upon much experience and observation, I say, *only* when heated sufficiently to produce such result, to the first statement; and to the second, *only* when chilled from a right heat; and as to the third, *i. e.*, the assumption that the phenomenon of hardening is explained by the alleged fact that chilling breaks up the larger particles, and produces a finer condition, I say, unsupported. At a right heat there will be produced by chilling, by hardening, the promised fine condition, with hardness. At a higher heat there will be as great hardness, but with it will come coarseness, a disorganized, uneven structure, as unlike the other as it is possible to conceive—the one as fine as flint, and as beautiful as a diamond, the other as coarse as pig-iron; both the same material, different parts of the same piece, if you please; so that to say, "heating and cooling slowly or quickly produce certain results," needs to be modified. Question of, How hot? comes into the account. As to "arrangement of diamond particles in temper drawing as shown by color."

Hardening does that arranging. Tempering, by many, is believed to change the grain, size of "particles." I don't believe it. So again annealing softens, by many is believed to mean *necessarily* changes the grain, makes the particles coarser. I don't believe that either. That it *often does, I know;* that it is *necessary* in order to soften, is another thing. Hardening at proper heat—at the refining heat—will produce the much admired, even-grained condition of fineness referred to. So will working properly at proper heat; so will cold working. No, no, we cannot settle the question of why steel hardens in this way. Let's have proof which proves. S. W. GOODYEAR.



IMPROVED DRILL HOLDER.

That "Phenomenon of Shrinkage."

Editor American Machinist:

It will probably be scarcely profitable to follow farther the shrinkage question brought to our notice by Mr. Williams. While he rejects our conclusions, he certainly shows that he had all the conditions, as they were assumed to have been by Mr. Cairns and myself. The piston heated in the blacksmith's fire was not heated uniformly. Mr. Williams says that he watched it to see that it was heated uniformly, which really means that, when he discovered that it was overheated in one spot, he turned it around and began to overheat it in another. It is also evident that the piston could not have been cooled uniformly. I assumed that he cooled it off with water. Mr. Williams denies that he did cool it off with water. On September 24 he wrote: "We finally had to cool it off, and when, on calipering the hole, we found it about $\frac{1}{32}$" smaller." If not cooled with water, how was it cooled? If he tried any of the other liquids that men use to cool off with, he would still find that the liquid has not been discovered that will cool off man or metal uniformly; but water is generally the best, and is, I hope, common and plenty in Mr. Williams' neighborhood. Mr. Williams' statements as a whole amply supply the conditions favorable for producing the phenomenon in the manner "intelligently" described in detail by Mr. Cairns.

Mr. Williams says that he "would not dare to use water with any kind of shrink fit.' "Water is an enemy of shrink fits." I have to acknowledge that I have often used water in connection with shrink fits, but I don't advise any one else to do so. I suppose it requires some mechanical judgment or instinct to do it with safety. You know when anything is shrunk on up against a shoulder, as it usually is, it will, as it cools, shrink away from the shoulder, so I usually begin sprinkling a little water slowly and carefully against the side adjoining the shoulder, to make that side shrink first and pinch the hardest, and let all the crawling be done from the other end.

FRANK H. RICHARDS.

Improved Drill Holder.

We illustrate herewith a drill holder for holding taper shank drills or other tools having taper shanks, while being used in the lathe.

As will be perceived, it consists of a taper socket having at the rear an open slot in which the flat at the end of the shank fits, and from which it projects slightly—sufficient so that the center which is in the end of the drill can be placed directly on the foot-stock center, thus insuring that it is in accurate alignment. The lever may be held in the hand or allowed to rest upon the carriage of the lathe.

They are made in various sizes to hold drills from ¼" to 2½" diameter by the Cleveland Twist Drill Co., Cleveland, O,, who have fitted up special tools, jigs, gauges, etc., for their accurate and economical production.

It creates quite a little whirl of excitement that the President has issued an order that persons employed within the various departments shall be promoted according to their efficiency. Well, how under the heavens should men be promoted?

During the year just past there have been built in Maine 134 vessels, the aggregate tonnage of which was 50,387.

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Not a Question of Power.

An English Inspector of Factories, Mr. Cook Taylor, has written a book on the "Modern Factory System," in which he calls attention to the fact that in the beginning the employer was a man "who bustled about among his work people and customers," but that now this "old type of the factory master is almost as extinct as the old machinery. His individuality was first merged in the mere capitalist; his very identity is now lost in the Limited Liability Company, a financial syndicate." Mr. Taylor's opinion is that another change is about to occur by the introduction of a form of power which can be carried to the homes of the workingmen, and there used in such a way as to enable them to compete with the factory, and that the results of this will be very beneficial in some respects.

There may be some kinds of factories in which this question of the cost of power is of supreme importance, and in which manufacturing cannot be economically carried on unless power can be economically obtained, but the factories in which other considerations do not far outweigh the question of cost of power are the exception. Division of labor; the advantage of conducting commercial operations connected with manufacturing on a large scale; the full employment of tools, machinery and appliances, etc., are usually of far greater importance than the cost of power, and we are not able to understand just how Mr. Taylor can have acquired so much knowledge of factories as he seems to have, without perceiving this fact.

For it must be evident to any one who takes pains to look into the matter, that the economies which can be introduced in the large factory devoted to a certain line of work, which it would be impossible to introduce in the smaller factory, reduce the question of the comparative cost of power to one of very small moment. Suppose we take such a case as the American Watch Factory at Waltham as an example. Here certain men perform certain operations continuously, and thereby attain a degree of proficiency which could never be attained by one who divided his time between several different parts of the work, as would be necessary in the small workshop. But this is by no means all; for a fact of equal importance is that the volume of work done is sufficient to justify the building of special machines for many operations which would necessarily have to be done by hand, or by far less efficient machines, in the small establishment. There is a vast difference, for instance, in the cost of punched work, depending upon whether the establishment in which it is done has only one or two punches for a dozen or more operations, or as many machines as there are operations and enough work to keep them going. Another case is with machine screws. Up to a certain point in the number of screws required by any establishment, it will not pay to put in automatic screw machines. But when the consumption of screws reaches a certain amount, varying with circumstances, the factory cannot afford to do without automatic screw machines. The relative cost of power has practically nothing whatever to do with the cost of the finished product in such cases as these, and there are other things which might be mentioned which show the same thing. We venture the assertion that there are very few branches of manufacture now carried on in large factories which could be as economically carried on in small shops, even if the small shops were supplied with power free of cost.

Electric Locomotives.

An electric locomotive has recently been constructed at the works of the Thomson-Houston Company, which upon trial pulled eight loaded freight cars about a yard in what is reported to be an entirely satisfactory manner. The weight of the locomotive is given as 43,000 pounds, and its speed, "when delivering 80 horse-power at the draw-bar, is about five miles an hour." The machine was built for the Whitin Machine Company for use about their works, and we suppose there were some peculiar conditions presented which made such a machine preferable to the ordinary locomotive in this case.

Nothing, so far as we have noticed, has been given as to the expenditure of coal required to do the work, or, in other words, the efficiency of the machine; but upon the simple fact that such a machine has been built and has drawn cars, we are again entertained with predictions to the effect that the days of the steam locomotive are numbered. One electrical journal says that "the time will doubtless come when all railway traffic will be handled by electrically operated trains," and that, "in addition to the cheapness of construction of the electric locomotive, as compared with the steam locomotive, it commends itself because expensive skilled operators will not be needed to manage it." To any one who knows anything at all about railroading, this latter statement will apper ridiculous, in view of the fact that the modern railroad engineer depends more and more upon the machinist for that part of the work which must depend upon an intimate knowledge of the machine and its construction, there being enough for the engineer to do who understands how to manage a train upon the road, and get it to its journey's end safely and on time—knowledge which is largely independent of the particular kind of machine handled by him. In short, a very large share, if not almost all of the skill acquired by locomotive engineers would be required just the same, whether steam or electricity were used as motive power.

The World's Fair—A Duty and an Opportunity.

There should go forth from the press of the country—without reserve—an earnest effort in favor of the World's Fair, so soon to be held at Chicago. Its location having been definitely settled upon, for reasons more or less satisfactory to the people of the United States, there is, in reference to it, only one duty before every American, and that is to work for the success of the Fair, its location being, after all, a matter of relatively small importance.

The main point, so far as the great State of New York is concerned, is that other States are coming forward with liberal appropriations for State exhibit purposes, and although a commanding site has hitherto been kept reserved for the purposes of a New York State exhibit, when wanted, New York has so far made no appropriation, and to the country at large appears to hold the unpopular attitude of sulking. That a legislative wrangle and deadlock at Albany over other matters defeated the chance of a World's Fair appropriation last winter, rather than any feeling of hostility to the Fair in the State at large, is a fact tolerably patent to most New Yorkers. But the question of greatest concern at present remains, and that is, is any cause, partisan or other, to be allowed to further prevent the voting of a substantial and fitting appropriation for the purpose of erecting buildings for and making a New York State exhibit?

So far as the general government of the United States is concerned, it appears to us that it, too, cannot afford to fail in the matter of doing its part, both in the way of making the Fair a credit and preventing it from being a disgrace to the nation. We cannot think the country is in danger of misapprehending either its duty or its interest upon either point.

As we understand the financial aspects of the case, the city of Chicago has herself raised fully two-thirds of the fifteen millions of dollars deemed necessary to insure the success of the Fair. Bearing in mind the fact that, after all is said, the burdens and benefits of the Fair were imposed upon that city, not by the votes of her own citizens, but by the votes of the representatives of the people of the United States in Congress assembled, there is certainly as little justice in the idea that Chicago should bear *all* the burdens of the Fair, as there is truth in the idea that she will reap all its benefits.

According to a press report, five Hungarian brass workers, who arrived at this port a few days ago by the steamer "Westernland," were sent back by the authorities, because it was found that they had come over here under an implied contract with Frank Alexander, foreman of a brass works in Bridgeport, Conn., to work for $1.35 per day, in place of other workers now employed at $1.70 per day. If this is an accurate statement of the case, it seems to have been one instance at least in which the contract labor law has accomplished some good.

The wages of American mechanics are based upon conditions found here—upon productive capacity, cost of living, etc. Every one who knows anything at all about the matter, knows that $1.70 per day is little enough for men possessing any degree of skill in brass working, and the only reason the Hungarian workmen agreed to work for less was because they were not posted as to the conditions found here. They would have been here but a short time before they would have discovered that $1.35 per day is very low wages in this country, and that by working for that amount they had done themselves and all other workmen here an injury. And it is to be noted that the injury in such cases is not confined to workmen, but necessarily extends throughout the whole social system. The general prosperity of communities in this country depends upon the prosperity of the mass of the people, and any manufacturing concern which succeeds in getting the wages of its employes much below the general average, while it may thereby secure a temporary advantage (though even this is by no means certain) is at the same time doing an injury to manufacturing interests generally.

Locomotive enginemen employed on the ordinary surface lines of the country, and who have never had an opportunity to see railroading as it is carried on in this city and Brooklyn, would find much to interest them in the elevated systems. The commoner accidents, for instance, that are always occurring on railroads, may mean a very different thing on the elevated roads from what they mean on any other. On the ordinary road, if a cylinder head blows out, it simply means that the engineer must block the valve over the ports on that side, and get the road cleared as soon as possible, and he will usually have sufficient time in which to do this without seriously obstructing things. On the elevated roads, with intervals between trains of from fifty seconds to two minutes, he must be pushed out of the way, while the flying cylinder head may kill one or more people on the street below, or wreck a store window, as was the case recently in Brooklyn, where the plate-glass window of a hat store was smashed to pieces by a flying cylinder head.

In Massachusetts it is the custom of the textile mills to fine employes for bad work, proprietors of mills claiming that it has been found that this is the only practical way in which to regulate the matter, as most employes, having no financial interest in turning out good work, would turn out altogether too much bad work; to the serious loss of the companies. There is no doubt, however, that this custom has been shamefully abused in many instances, fines having been imposed to such an extent as to seriously cut down wages, when the bad work was due mainly, if not solely, to poor materials furnished to work with, or to the poor condition of the machinery used. Finally public sentiment upon the matter became so strong that a law was passed prohibiting employers from imposing such fines. This law has just been declared unconstitutional by the Massachusetts Supreme Court, Judge Holmes dissenting.

We have received the "Annual Circular"

of the Newark Technical School, which is a free evening school for young men, located at 21 West Park street, Newark, N. J. The leading manufacturers and other citizens of Newark subscribe annually for the support of this school, these subscriptions enabling it to take advantage of a law of New Jersey, by which the State gives to any such school an amount equaling the voluntary subscriptions up to $5,000. To judge from this circular, the school has been, and is, doing a good work for the young men of Newark who wish to acquire such an education as will enable them to follow mechanical pursuits intelligently. The director is Charles A. Colton, E. M.

We have received from the Literary Bureau, 277-278 Stewart Building, New York City, a pamphlet describing the latest and most approved appliances for keeping card indexes for libraries (public or private), and for drafting rooms and business offices. The descriptions and illustrations should be of interest to those who appreciate the importance of having business affairs systematized. A list of manufacturers is given using the apparatus described, in which we notice the names of a number who are very prominent in the mechanical world.

In our issue of October 29 we mentioned the Wells Memorial Institute, of Boston, and the work it is doing there on behalf of men who work at trades or other occupations. We are now informed that what are called the Lowell Free Lectures commenced in the Institute building, 987 Washington street, the first week in November, and are to be continued each week for a term of fifteen weeks. The lectures are of a thoroughly practical nature, and designed specially to interest workingmen and mechanics. They include lectures on electricity, steam and the steam engine, valve motions, boilers, heating systems, belts and shafting, testing of engines and boilers, indicator practice, building and architecture, etc., all by well-known specialists in these lines of work.

Mr. T. T. Parker, of Springfield, O., who has occasionally contributed interesting articles to our columns pertaining to the management of steam plants, has accepted a position as inspector with the Fidelity and Casualty Insurance Company.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(543) J. H., Waterford, N. Y., writes: Please give a receipt for a mixture for chandelier work, and one for a soft valve mixture same as used for steam and water. *A.*—For chandelier work use from 8 to 10 ounces of zinc to one pound of copper. For valves or all castings subjected to a steam pressure use 20 pounds of copper, 1½ pounds of tin, 1 pound of lead, and one pound of zinc.

(544) G. E. R., Sanford, Fla., writes: Please advise me of the quickest and cheapest method to tin railroad car brasses so that they can take the lead lining. *A.*—The bearings are first bored, they are then placed on a coke fire and allowed to become well heated, then they are cleaned with muriatic acid and tinned. They must be warmed again, so that the tin is in a condition for the lead to adhere to it. They are then placed on a mandrel to receive the lining of lead, The device for holding the bearing during the lining can be made of very simple construction. It should be so designed that the bearing can be clamped only central with the mandrel, which will make the lining of uniform thickness over the bearing. The radius of the mandrel should be never more than $\frac{1}{32}$ to $\frac{1}{16}$ of an inch of the radius of the journal which the bearing is to fit. The lead lining should not be more than $\frac{1}{16}$ of an inch thick.

(545) E., Riverhead, N. Y., writes: Where can I get an idea as to how many feet of heating surface there should be in proportion to the feet to be heated? *A.*—We assume that you mean the number of cubic feet of air to be heated in a building. This depends much on the class of building and its location. Positive rules for steam heating, which will be correct for all parts of the country, cannot be given, as the conditions are varied, depending upon locality, climate, and heat required, and also on the conditions found to exist in any particular building. When a building has a large glass surface, or is composed of iron, etc., the air is cooled more rapidly than in ordinary buildings with average windows and average conditions. Buildings of this kind will require an extra amount of heating surface, as the air is cooled by coming in contact with the surfaces of the windows and walls. The steam engineer has nothing more than the averages to depend upon for his guidance. In case of small corner rooms, with low pressure of steam, in climates like that of New York, one square foot of average radiator surface to each 50 cubic feet of air space is generally considered ample. With large rooms 1 to 60 is often enough; and in halls and stores 1 to 100 is usually considered sufficient, while in many churches 1 to 150 is all that is needed. 2. Will an engineer who holds a license for a 25 or 50 ton boat have a right to go as first assistant on a 200-ton steamer? *A.*—That will depend on the class of license; if it is a special engineer's license another one will be required to act on a 200-ton steamer. 3. We do not know to what light you refer in your third question.

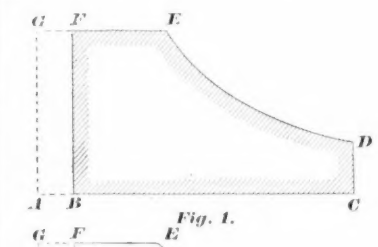

Fig. 1.

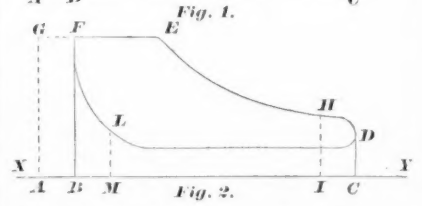

Fig. 2.

(546) X. Y., Sacramento, Cal., writes: I have lately taken up the study and practice of indicating engines. There are some points as yet which I do not fully understand. For instance, I do not know how to figure out the percentage of clearance, and therefore cannot show the clearance line on the card. Kindly explain. *A.*—Clearance is measured as a certain percentage of the displacement of the piston; the latter is obtained by multiplying the area of the piston in square inches by the length of the stroke in inches; the product will be the displacement in cubic inches. The clearance is the volume included between the piston, when at the end of its stroke, and the valve seat. This volume in cubic inches must be computed; but since it often involves a great amount of labor, it is sometimes found in a practical way by moving the piston to end of its stroke, and then filling the space between this end of cylinder and the piston with water up to the valve seat; the number of cubic inches of water put in will represent the clearance in cubic inches. If now the piston displacement is 7,500 cubic inches and the clearance is 525 cubic inches, then the clearence in per cent. of the piston displacement is found by the simple rule of proportion, in which the piston displacement is said to be 100 per cent. Hence we have

$$7{,}500 : 525 : : 100 : x,$$

which gives us $\frac{525 \times 100}{7{,}500} = 7$ per cent.; that is, the clearance is 7 per cent. of the piston displacement. To show this clearance on an indicator card we simply add 7 per cent. to the length of the stroke represented by the card. Thus, for instance, let $B\ C\ D\ E\ F$ (Fig. 1) represent an ideal card, in which $B\ C$ represents the stroke, and say that this line is 4 inches long; to this we must now add $A\ B$, equal to 7 per cent. of $B\ C$, which is again found by the rule of proportion, thus:

$$100 : 7 : : 4 : x;$$

hence $\frac{7 \times 4}{100} = .28$ of an inch for the length of $A\ B$. The rectangle drawn on $A\ B$ represents the clearance in per cent. of the piston displacement and $A\ G$ the clearance line. In a similar way the clearance line is drawn on a card taken from the engine. Let Fig. 2 represent such a card, the line $X\ Y$ being the line of perfect vacuum. Through the extreme point D at one end of the card draw a line $D\ C$ perpendicular to $X\ Y$; also through the extreme point on the other end of the card draw a line $F\ B$ perpendicular to $X\ Y$; then $B\ C$ will represent the stroke of the engine, and if now the clearance is 7 per cent. of the piston displacement, add to $B\ C$ a line $A\ B$ equal to 7 per cent. of $B\ C$, and through the point A draw the clearance line $A\ G$ perpendicular to $X\ Y$. The clearance line can also be located without finding the percentage of the clearance. Thus, if the volume of the clearance is 525 cubic inches and the piston displacement is 7,500 cubic inches, then the clearance is $\frac{525}{7{,}500} = 0.07$ of the displacement. If now the length $B\ C$ of the card is 4 inches, then the length of $A\ B$, which must be added to the line $B\ C$, is equal to $4 \times .07 = .28$ of an inch as before. Sometimes in computing the quantity of steam consumed, a line $H\ I$ parallel to $D\ C$ (Fig. 2) is drawn on the diagram; the distance between $H\ I$ and $D\ C$ is equal to $A\ B$, the clearance space, so that the space occupied by the steam at the point I of the stroke is just equal to the piston displacement for a single stroke. If now the mean net area of the piston is, say 77 square inches, and the stroke is 18 inches, then the displacement is $77 \times 18 = 1{,}386$ cubic inches; and if the number of single strokes per minute is 200, then per hour we have $200 \times 60 = 12{,}000$ strokes; hence the displacement per hour is $\frac{12{,}000 \times 1{,}386}{1{,}728} = 9{,}625$ cubic feet. Assuming that the line $H\ I$ represents by the indicator scale a pressure of 27.5 pounds, the weight of a cubic foot of steam at that pressure is .0695 pound; hence the weight of the steam per hour in the cylinder at the point I in the stroke is $9{,}625 \times .0695 = 668.93$ pounds. Now, in order to find the amount of steam consumed, we must deduct from the above quantity the amount saved in the clearance space upon the return stroke of the piston, increased by the exhaust valve closing before the end of the return stroke. For this purpose draw the line $L\ M$, making $B\ M$ equal to the clearance space $A\ B$. If now the clearance is 7 per cent. of the piston displacement then the volume of steam saved per hour from the point where $L\ M$ crosses the compression curve will be represented by the line $A\ M$, which is equal to $7 \times 2 = 14$ per cent. of the piston displacement. The latter we have found to be 9,625 cubic feet; hence $9{,}625 \times .14 = 1{,}347.5$ cubic feet per hour of steam saved. Let now $L\ M$ represent 22 pounds; the weight of a cubic foot of steam at that pressure is .0561 pound; hence the steam saved per hour is $1{,}347.5 \times .0561 = 75.59$ pounds. The steam then actually exhausted is $668.93 - 75.59 = 593.34$ pounds per hour.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Ready-made cut Iron list gears. See page 20.

Link-Belting and Sprocket Wheels.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Engineering Co., Philadelphia and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

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Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Light Special Machinery and Tools to order. The Meriden Machine Tool Co., Meriden, Conn.

$13 60 I Dea L. Drawing Stands. The original. Send for postal. W. S. Rogers, Troy, N. Y.

S. A. Smith, 23 South Canal Street, Chicago, Ill., agent for Holbrook's Raw Hide Blanks for Gears.

Our Automatic Gear Cutting Machine will increase production 50%. The Superior Mach. Wks., Clev'd, O.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Planer Chucks and 13" Upright Drills. For cuts and price address G. W. Jordan, No. 4 Wayne Street, Worcester, Mass.

S. W. Card & Co., Mansfield, Mass., make everything in the line of Taps and Dies. S. A. Smith, 23 S. Canal St., Chicago, Western Agent.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson St., Chicago, Ill.

Save small iron from foundry refuse. It pays. Use the Woodruff Pat. Separating Machine, Audubon Machine Works, New Haven, Conn.

Thos. Pray, Jr., 193 *Times* Build'g, N. Y., attends to calls for Indicating and Testing Steam Plants, Water-works, Locomotives & S. S.'s. Write or call.

For immediate delivery—Sensitive Drills, 20, 25 and 32-inch Drills, with all the latest improvements. W. P. Davis, Rochester, N. Y.

N. Y. City Bolt & Nut Co., Limited, 33 and 35 Desbrosses St., N. Y. City, manufacturers of Machine Bolts of every description. Write for estimates.

Milliken & D'Amour, No. 151 Cedar Street, New York City, designers and builders of labor-saving and automatic machinery and tools to order.

"Roper's Hand-books for Eng'rs and Firemen." Descriptive Catalogue mailed free to any address. Edw. Meeks, Pub., 1012 Walnut St., Phila., Pa.

"Hawkins' Calculations for Engineers," 10 Parts, 25c. each, bound, $2.50; Catalogue free; Theo. Audel & Co., Pubs., 91 Liberty St., N. Y.

25" 32" 37" 42" "Only Drill Press built on 'Ko-rekt' principles, even if they come from Jersey." Gould & Eberhardt, Newark, N. J.

Complete treatise on Screws and Screw-making, with clear and concise explanation of the methods; 95 illustrations. Price, $1.25 postpaid. E. & F. N. Spon, 12 Cortlandt Street, New York.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

Club Rates.—If no one is getting up a club for the AMERICAN MACHINIST in your town or establishment, send for Circular of New Club Rates, and try it yourself. Address AMERICAN MACHINIST, 96 Fulton St., New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton St., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

MANUFACTURES.

A new iron foundry is to be started at Brewster, N. Y.

E. P. Howland will start a machine shop in Flatonia, Tex.

The erection of a cotton-mill is proposed at Pittsburgh, Tex.

Iron works will, it is stated, be established at Elkin, W. Va.

A $10,000 foundry plant is to be established at Oaksdale, Wash.

A machine shop will be established at Statesboro, Ga., by W. W. Davis.

Efforts are being made to establish a cotton factory at Cartersville, Ga.

W. W. Davis is reported as to establish a machine shop at Statesborough, Ga.

The Coburn Trolley Truck Co. will erect a new factory near Holyoke, Mass.

An addition is to be built to Wildman Brothers' boiler shop at Saginaw, Mich.

The Donaldsonville (La.) Ice Co. will, it is stated, put in a fifteen-ton ice machine.

The Steel Barbed Fence Ribbon Company will establish a plant at Valverde, Col.

J. P. Angell and others will erect an ice factory and cold storage plant at Pine Bluff, Ark.

An iron foundry will be established in Pittsburgh, Tex., by J. A. Cornish, of Arkansas.

The Pennsylvania Railroad Company is erecting a 138x238 passenger car shop at Renovo, Pa.

Negotiations are pending for the establishment of an iron foundry and pipe works in Salem, Va.

A 10-ton ice factory will be erected at Atlanta, Ga. W. A. Henderson & Son can give information.

The Cambridge Iron and Steel Company, of Cambridge, O., will enlarge its plant at an early date.

The Louisville & Nashville will probably erect a repair shop and roundhouse at Montgomery, Ala.

An electric light plant will probably be erected at Bastrop, Tex. The mayor can give information.

The New Rome (Ga.) Street Railroad Co. will erect an electric-power plant to operate its railroad.

The Boston & Albany has begun work on a new stone passenger station 60x25 feet at Hinsdale, Mass.

It is announced that the Buffalo Cast-iron Pipe Company will erect a large foundry at Buffalo, N. Y.

The Fort Smith Milling Company's recently burned plant at Fort Smith, Ark., is to be rebuilt.

A bonus has been raised for the establishment by a company of another iron foundry in Pittsburgh, Texas.

The Mineola (Texas) Harrow and Plow Company has been incorporated, with a capital stock of $10,000.

The Aluminum Alloy Metal Co., of Hampton, Ia., has been incorporated, with a capital of $25,000.

The molding factory at Copake Iron Works, N. Y., which was recently destroyed by fire, is to be rebuilt.

The work of rebuilding the Pittsburgh (Pa.) Wire Company's recently burned plant has commenced.

The Harriman (Tenn.) Tack Co. has made arrangements to increase the capacity of its tack factory.

An iron foundry and machine shop will be established at Jefferson, Tex., it is stated, by Murray & Porter.

Capt. Dudley Avery and others talk of starting a plant for the manufacture of fire-brick, at New Iberia, La.

Efforts are being made by F. H. Halloway and others to start a cotton and woolen-mill at Marble Falls, Tex.

The Dominion Barb Wire Works Co., of Montreal, Can., will establish a branch factory at Winnipeg, Man.

The Steam Heater Co., of Susquehanna, Pa., is talking of erecting a new and larger machine shop next season.

Robert Smith has purchased the Hancock Iron Foundry at Winchester, Va., and will probably operate same.

It is reported that the wire works at Elgin, Ill., are to be purchased and put into operation by local capitalists.

The Blairsville Rolling-mill and Tin-plate Company, of Blairsville, Pa., have been chartered. The capital is $75,000.

M. B. Schenck & Co., Meriden, Conn., manufacturers of casters, intend to open up a new foundry for small castings.

There is a possibility of a $35,000 plant being established at Deadwood, Dak., for the reduction of refractory ores.

Messrs. Franck & Rasberry are making arrangements to erect a shop for engine and boiler works at New Berne, N. C.

Negotiations are pending for the establishment of another ice factory in Austin, Tex. Haigler Bros. can give information.

The Eureka Silk Manufacturing Company, of East Hampton, Conn., is soon to put a new 200 horse boiler in its mill.

Citizens of Galesburg, Ill., have raised $50,000 toward the $600,000 required to build a beet sugar factory in that town.

A new steel bridge is to be erected by the Peoria, Decatur & Evansville Railroad across the Wabash River at Grayville, Ill.

The Lincoln Iron Works, Rutland, Vt., are making additions to their property, preparatory to increasing their business.

Edson Gregg, of Gregg Brothers, of Kansas City, Mo., is investigating with a view of erecting a grain elevator in Mobile, Ala.

It is said that a new enterprise, to employ 50 skilled workmen, will be established at Gadsden, Ala., at a cost of $50,000.

The Hoyt Metal Co., of St. Louis, Mo., have completed a new factory at Arlington, N. J., which they will shortly occupy.

The Neracher and Hill Sprinkler Company, with a capital of $250,000, will commence business at Warrer, O., on January 1.

An increase of $100,000 is understood to have been made in the capital of the Troy Malleable Iron Company, of Troy, N. Y.

Cutler, Lyons & Field, of Greenfield, Mass., are to erect a new factory 38x60 feet, and three stories high, for the manufacture of shoes.

The Backus Manufacturing Company is erecting a plant at Williamsport, Pa., for the manufacture of the Backus Portable Steam Heater.

A bonus has been raised for the establishment of another iron foundry in Pittsburgh, Texas. Also a cotton tie factory may be erected.

D. C. Ebaugh, of Charleston, S. C., is endeavoring to organize a $100,000 stock company to establish a fertilizer factory in Tampa, Fla.

W. C. Young & Co., Worcester, Mass., issue a catalogue of shears and punches made at the works, both for power and hand work.

The city of Paragould, Ark., is reported as making preparations for the erection of an electric light plant. The mayor can give information.

J. J. Harper and others at Monroe, La., are organizing a company for the purpose of establishing car shops and an iron foundry at Monroe.

A foundry and machine shop will be erected at Wytheville, Va. R. A. Moore will be general manager, and Charles Smithers secretary and treasurer.

At Unionville, Conn., the Platner & Porter Company is about to put in a new engine at its mill, and the Upson Nut Company will run its factory by steam.

W. E. Jenkins and others have been incorporated at Rock Hill, S. C., as the Jenkins Safety Catch Gun Company, capital $20,000, to make a patented fire-arm.

The Baker Iron Company, at Jasper, Tenn., is preparing to purchase a full outfit of machinery for the manufacture of bar-iron and steel, wagon hardware, etc.

The Potter & Atherton Machine Co., Pawtucket, R. I., has received the order for the picking machinery for the Lambert Point Knitting-mill, Norfolk, Va.

The Linden Steel Co., Pittsburgh, Pa., is building a new twenty-five-ton open hearth furnace in its mill, and putting in Siemens gas producers to supply fuel.

It is reported that the Goshen Land and Improvement Company, of Goshen, Va., has closed a contract with parties to put in operation the Goshen Rolling-mill.

A large foundry, giving employment to about 300 men, will be established in Buffalo, N. Y., within a few months. The foundry will be in running order by spring.

The Ashland (Ky.) Electric Light and Power Co. has increased its capital stock from $25,000 to $100,000, and will put in new motors to furnish power to small manufactories.

The Maryland Phosphate Company, recently organized at Anthony, Fla., to develop phosphate, etc., is now at work erecting a plant to mine, wash and dry 100 tons daily.

The Alabama Midland has recently purchased for $35,000 the machine shops at Montgomery belonging to the Louisville & Nashville, and is preparing to put them in operation.

Nicholson & Waterman, Providence, R. I., send us a catalogue of horizontal drilling and boring machines made at the works. Every mechanic in charge of works ought to have it.

W. L. Henson, manager of the Lakewood Heights Land Company, Atlanta, Ga., is credited with the statement that a large iron-mill will be established at Lakewood Heights in several months.

W. P. Hix, of the Edison Electric Light Co., New York, is endeavoring to organize a $1,000,000 electric light company at Baltimore, Md. If organization is perfected full outfit will be needed.

The new plant of the Cherokee Iron Manufacturing Company, at New Birmingham, Texas, is about completed. The Cherokee Furnace will go into blast in a few days. Its capacity is 50 tons.

The Anheuser-Busch Brewing Co., of St. Louis, Mo., has, it is stated, completed arrangements for the erection in Houston, Tex., of a $125,000 ice factory, with a capacity of sixty tons of ice per day.

The Grand Trunk locomotive shops at Stratford, Ont., are being enlarged by the addition of a new building, and their efficiency has lately been increased by the addition of $5,000 worth of new machinery.

P. J. Kuhbacker, L. T. Everett, H. D. Halbert and others have incorporated the Electric Scales Co., at Covington, Ky., for the manufacture of weighing scales, etc. The authorized capital stock is $1,000,000.

J. B. Congle, Frank Bond, J. T. Clarke and others have incorporated the De Land (Fla.) Manufacturing Company, to manufacture ice, and operate an iron foundry and machine shop. The capital stock is $50,000.

The Houston City Street Railway Co., Houston, Tex., will build a car house and car shops at once. It is proposed to erect a building 250x14 feet in size, and not only repair old cars, but construct new ones.

W. H. Harris, J. N. Huston and P. W. Hardin have incorporated the American Gas Company, to establish and operate gas works, etc., at Frankfort, Ky. The capital stock is reported as to be $10,000,000.

The Webster, Camp & Lane Machine Company, of Akron, Ohio, it is said, have decided to remove their works to Kent, Ohio, where 14 acres of land have been donated them by the business men of that place.

The Boston Gear Works, 31 Hartford street, Boston, Mass., send us cards and circular relating to the making of about all kinds of gears in use. The members of this company are specialists in their line of work.

A company has been organized at Birmingham, Ala., by Isaac P. Gilbert, of Michigan, with a capital of $1,750,000, to be known as the Mammoth Manufacturing Co., for the manufacture of agricultural implements.

The Corning Steel Company have been organized at Chicago, with a capital stock of $250,000, for the manufacture of iron and steel. Incorporators, Charles S. Corning, Frank B. Felt and William O. Johnson.

W. B. Guimarin, J. E. Engles, E. D Stockton and E. P. McBurney have incorporated the Guimarin, Engles & Stockton Company, at Atlanta, Ga., to engage in galvanized iron and tin work, plumbing, etc. The capital stock is $15,000.

The Cranston Boiler Works, Providence, R. I., are nearly completed, primarily for the manufacture of the Gray patent and other house-heating boilers. The plant is a modest one at present, but the firm hopes that it will grow.

The assignees of the Blandon Iron and Steel Company, of Blandon, Pa., are endeavoring to organize a new company, with the creditors as stockholders. It is quite probable that a settlement will be effected and the works started up again.

The Taylor Engine Works, at Chambersburg, Pa., have started up under the new management with a force of eighty men. The works have been idle since February last, when the company then operating them became financially embarrassed.

The citizens of Marion, Ind., have subscribed for $40,000 of the stock of the gun factory which Dr. Richard Gatling proposes to erect at that place. The total capital will be $1,000,000, of which $400,000 will be retained by the originator of the scheme.

Application for a charter has been made for the Carlin Manufacturing Company, of Pittsburgh, to manufacture iron and steel castings. David Carlin, William A. Kerr, G. Ross Williams, R. F. Kennedy, and W. S. Swartz are the incorporators of the new concern.

It has been currently reported that the Swift Powder and Cartridge Company, recently incorporated at Covington, Ky., would locate its plant in Tallapoosa, Ga. Work upon the factory and mills will be pushed as fast as possible; 1,000 hands will be employed.

Frank Eison will build and operate a foundry at New Haven, Conn., next spring. Stock to the amount of $50,000 has been subscribed toward the formation of a stock company, and in the event of such a company being organized, the plant will be an extensive one.

The Marietta (Ga.) Electric Light Co., at a recent stockholders' meeting, voted to increase its capital stock $10,000, and put in an incandescent electric light plant. The additional stock is to be taken by Campbell Wallace, Jr., who will also be the manager of the plant in future.

The firm of Brackett & Bailey has been established at 214 First avenue, South Minneapolis, Min. The firm will do a general machine business, and manufacture specialties, perfecting the design when required. Drawings and blue prints will be made for those requiring them.

There is water-works agitation in Monticello, Wash; Springfield, Utah; Mobile, Ala.; Radnor, Pa.; Margaretville, N. Y.; Pittsfield, Mass.; Weston, W. Va.; Wilmington, Del.; Dillon, Mont.; Cloverport, Ky.; Lawrenceburgh, Tenn.; Montoursville, Pa., Wurtsboro, N. Y.; Newburgh, N. Y.

An effort is being made to establish iron and steel works at Tacoma, Wash. Alexander Delano, of Detroit, Mich., is the prime mover in the enterprise, which includes the building of blast furnaces and rolling-mills. A committee has been appointed to canvass for $200,000 in subscriptions.

The Keystone Iron Works, at Kansas City, Kansas, which recently was closed by an attachment, will be started up again, temporarily at least, and all contracts under way will be finished. Unless arrangements can be made whereby the company can pay off its indebtedness the works will be sold.

The Falcon Iron and Nail Company, at Niles, O., is enlarging its works to increase the production of iron, and has placed an order for a 22-inch cold rolling train with the Lloyd Booth Company, of Youngstown, O. The latter has shipped an 8-inch mill shear to the Lake Erie Iron Company, of Cleveland.

The Harris Car Company, with a capital of $1,000,000, will probably locate at Putnam, Conn., providing the citizens of the latter place will submit to the terms proposed, which will give the company 50 acres of land, subscriptions to $50,000 of stock and exemption from taxes for a term of years.

The Wilmington Dental Manufacturing Company, Wilmington, Del., are moving their New York establishment and consolidating their business at Wilmington, where they are now putting up a factory for the manufacture of artificial teeth. A 75 horse-power vertical engine will be required to furnish power.

The Steel Truss Car Wheel Company, at Edwardsville, Ill., has begun the manufacture of car wheels. The projectors intend to enlarge the plant and increase the working force as the business requires. Jacob Dunstedter is the inventor of the wheel and president of the company, and Gustav Cramer, of St. Louis, vice-president and treasurer.

Carnegie, Phipps & Co., Limited, of Pittsburgh, have recently purchased fifty-five acres of land adjoining their Duquesne Steel Works, at Duquesne, Pa. The purpose for which this additional ground has been secured has not been given out, but it is understood that it was secured with a view of making extensive additions to the Duquesne Steel Works.

The large new plant of the Monongahela Iron and Steel Company, at Hay's Station, a short distance from Pittsburgh, has just been completed. The new works are well equipped, and will employ between 280 and 300 men. The principal products will be pig iron and muck bar. The company has a large stock of ores, coke and other materials already on hand.

The Trenton Malleable Iron Company, of Trenton, N. J., have found it necessary to erect additional buildings, which will double their capacity. The extensions are now completed, and will enable them to fill up all orders promptly. Among their specialties are car couplers, etc., the company being the sole manufacturers of the Africa & Gibson car replacer.

The new plant of The Ball & Wood Company, Elizabeth, N. J., is so far completed that shipments of engines have commenced, and the works have been running night and day since October 1st, to clear up their order books. Among others, orders for the Improved Ball Engines have already been executed as follows: 150 H. P. for the State House, Trenton, N. J.; two 150 H. P. for the Edison Electric Illuminating Company, of Paterson, N. J.; 75 H. P. for the Saugerties Electric Light Company, Saugerties, N. Y.; 100 H. P. for the Meriden Electric Light Company, Meriden, Conn.; 75 H. P. for the Edison General Electric Company, Rockledge, Fla; 100 H. P. for the Leominster Worsted Company, Leominster, Mass.; 150 H. P. for R. H. Macy & Co., New York; two 75 H. P. for the Four Seasons Hotel, Cumberland Gap, Tenn.; 150 H. P. for the Electric Light Company, Madison, N. J.; 150 H. P. for the Laconia Car Company, Laconia, N. H.; 300 H. P. Cross Compound, for the Edison Company, of Paterson, for street railway service.

Proceedings of the Mechanical Section of the American Association for the Advancement of Science.

WASHINGTON MEETING.

(Continued from last week.)

ON THE EFFICIENCY OF SCREW PROPELLERS. BY PROF. J. E. DENTON.

The paper points out that the statement to be found in some standard treatises and text books, to the effect that the screw propeller realizes but about 38 per cent. useful effect out of a given indicated horse-power, is inconsistent with modern data regarding screw propulsion. This was one of the generalizations of Froude, the great expert regarding marine propulsion, and was arrived at as follows: Out of a given indicated horse-power it was assumed: First, that 15½ per cent. was lost through the "stern resistance" caused by the presence of the propeller at the stern interfering with the support of the latter by the following wave or the replacement wave of Scott Russell's theory. This was determined by towing models with a dynamometer, first without a screw and second with a screw, detached from the model, but made to follow close behind it. Second, about 4 per cent. was estimated to be lost by the friction of the screw in the water. There is no very accurate knowledge of this element of loss today. Third, 13 per cent. was assumed to be consumed in the friction of the engine unloaded, and 13 per cent. more was assumed to be expended by the extra friction due to the load on the engine. Fifth, about 7 per cent. was assumed to be consumed by the air-pump. The only authority for this was a statement by Tredgold. Sixth, the slip was assumed at 10 per cent. The total loss, therefore, foots up about 62 per cent., leaving about 38 per cent. of the indicated power available to propel the hull. Dynamometer tests have always shown considerably higher efficiency than this, affording from 65 to 70 per cent., as shown in the following table. Also computations of efficiency based on an estimate of the resistance of the hull by Rankine's Augmented Surface Theory, on a number of American boats, indicate an efficiency of about 67 per cent. for both screws and paddles. Rankine's formula for resistance is considered to err on the side of giving too low a horse-power for a given speed, so that efficiencies calculated by it are too low, if in error. The air-pump resistance of marine engines is now known to be only about 1½ per cent. of the indicated power. The friction of the engine unloaded has been found to be as low as 8 per cent. A revisal of Froude's estimate with these modifications might therefore show nearly 60 per cent. efficiency. Rankine's estimate of the efficiency of the Warrior, a screw vessel, in the British Navy, made the stern resistance 7 per cent., the slip 9 per cent., the screw friction 2 per cent., and the friction of engine loaded, including air-pump, 22 per cent., making the total loss 40 per cent., and the efficiency 60 per cent.

The first line of the following table (page 11) applies to the steamer Admiral, whose efficiency Rankine also estimated at 60 per cent. The remaining boats for which the hull resistance is estimated ply on the Hudson River, the Orange and Bergen being ferryboats, the others well-known passenger boats.

RADIATION OF THE BARRUS UNIVERSAL CALORIMETER. BY PROF. D. S. JACOBUS.

As this calorimeter appears to be all that need be desired for determining the moisture in steam up to any degree of wetness, it is useful to know what error is involved in using the instrument, and neglecting any correction for loss of heat by radiation, as exact allowances for this effect are difficult to make without considerable care and expenditure of time. The writer had accordingly passed through the instrument steam which was superheated by gas flames, so as to be exactly saturated when it entered the two parts of the apparatus, and found that the loss by radiation of the separator portion is probably not more than one-third of

EFFICIENCY OF SCREWS AND PADDLES.

Name.	Date.	Length. Ft.	Breadth. Ft.	Draught.	Displacement. Gross tons.	Wetted Surface. Square feet.	Coefficient of augmentation.	Augmented surface.	Indicated horse-power.	Speed in knots.	Per cent. of slip.	Per cent. of indicated power available to propel hull.
Feathering Paddles.												
Admiral	1860	.....	.....	.....	.....	.....	.....	8560	744	12 0	22	.60
City of Fall River	1884	260	42	12′	2350	11000	1.26	13804	1616	14.0	20	.68
Radial Paddles.												
Mary Powell	1879	286	33½	6′	857	7377	1.08	7981	1600	16.65	16½	.68
Sylvan Dell	1880	178	25	4′ 10″	305	3737	1.20	4495	686	15 3	20½	.68
Rhode Island	1877	325	45	10′	2513	13695	1.18	16000	2300	15 0	17	.69
Orange	1890	211	32	7′ 8″	.....	5571	1.32	7347	490	10.4	27	.55
Single Screw.												
Homer Ramsdell	1889	211	32	11′	611	7365	1 21	8839	1030	13.67	11	.68
City of Kingston	1886	250	34	10′	700	8260	1.18	9736	1120	14.0	15	.69
Bergen, using one screw at stern	1890	200	32	8′ 10″	.....	5788	1.30	5788	7524	10.5	18	.60

In the above examples the power to propel the hull is estimated from the augmented surface. In the following cases the power to propel the hull was measured by a dynamometer at the thrust block of the screw shaft.

Single Screws.												
Rattler	1840	176½	32′ 8″	.....	888	.....	.....	.....	335	19.2	.....	.70
Vlaardinger	1890	70	14′ 9″	5′	69	.....	.....	.....	170	10 5	13.4	.69
Yarrow's Torpedo Boat	1883	100	12′ 6″	.....	40	.....	.....	...	230	15.0	.....	65

one per cent. of priming units, and for the heat gauge 0.08 per cent. In other words, in using the instrument, if no attention is paid to corrections for radiation, and the percentage of moisture estimated in the usual manner, the total error of the result, if both the separator and heat gauge are used, would probably be less than $\frac{4}{10}$ per cent., and if the heat gauge only is used, 0.08 per cent.

ON AN AUTOGRAPHIC BELT DYNAMOMETER. BY PROF. THOMAS GRAY.

In the measurement of the power required to drive dynamos for electric street cars, the writer had met the need of some means of measuring power more continuous than the taking of indicator cards at frequent intervals, the variation in the load being very rapid. He had, therefore, applied an autographic arrangement in connection with the Hopkinson belt dynamometer. The latter operates by drawing the two sides of a belt together with idler pulleys, so as to form a definite angle in the belt, measurement being made of the force required to hold the two idler pulleys in a given position, the difference of tension on the two sides of the belt causing the frame carrying the idler pulleys to be forced in one direction. Dr. Gray attached a piston to the frame carrying the idler pulleys, which pressed upon a rubber diaphragm, underneath which was a mass of water. Leading from the water vessel was a small pipe which connected with a vessel of mercury, in which was placed a vertical glass tube open at both ends. In the mercury tube there was a float carrying a pencil which was kept in contact with paper on a cylinder rotated by connection with the engine shaft. The difference of tension on the two sides of the belt was therefore communicated to the diaphragm, thereby forcing water into the mercury vessel, which caused the level of the latter in the tube to vary and move the float with its pencil. The movement of the pencil was therefore proportional to the force transmitted by the belt, and the area of the diagram described upon the paper was proportional to the horse-power expended. The apparatus was stated to have worked very well for the measurement of about 100 horse-power at the power station of the Terre Haute Electric Railway.

RELATIVE COMMERCIAL ECONOMY OF BEST MODERN TYPES OF COMPOUND AND TRIPLE-EXPANSION ENGINES. BY PROF. J. E. DENTON.

The most economical steam engine plants of the present time are the stationary or land plants, of Corliss or trip motion automatic cut-off multiple-expansion engines, combined with the several types of standard boilers, feed-water heaters, et The average* marine compound or triple-expansion plants expand steam a less number of times than the corresponding stationary type, in the ratio of about 1 to 2, and their consumption of steam exceeds that of the best mill plants in the ratio of about 1 to 1.2. The following table and deductions show the relative commercial economy of the compound and triple type for the best stationary practice. The table is based on the tests of Prof. Schroeter, of Munich, of engines built at Augsburg, and those of Geo. H. Barrus on the best plants of America, and of detailed estimates of cost obtained from several first-class builders.

Steam plants of 500 indicated horse-power.	Trip motion, or Corliss engines of the twin compound receiver condensing type expanding 16 times. Boiler press. 120 lbs.		Trip motion, or Corliss engines of the triple expansion four-cylinder receiver condensing type expanding 22 times. Boiler press. 150 lbs.	
	Lbs. water per hour per H.P., by measurement.	Lbs. coal per hour per H. P., assuming 8.5 lbs. actual evaporation.	Lbs. water per hour per H.P., by measurement.	Lbs. coal per hour per H. P., assuming 8.5 lbs. actual evaporation.
Best performance	13.6	1.60	12.56	1.48
Probable reliable performance	14.0	1.65	12.80	1.50

Increased cost of triple-expansion plant per horse-power, including boilers, chimney, heaters, foundations, piping and erection. $4.50

	Plant used 300 days, 10 hours per diem.	Plant used 360 days, 24 hours per diem.
Total annual expense for coal at $4.00 per ton. Compound plant.	$9.90 H. P.	$28.50 H. P.
Total annual expenses for coal at $4.00 per ton. Triple plant	9.00 "	25.92 "
Annual saving of triple plant in fuel	0.90 "	2.60 "
Annual interest at 5% on $4.50	$0.23	$0.23
Annual depreciation at 5% on $4.50	0.23	0.23
Annual extra cost of oil, 1 gallon per 24 hour day, at $0.50, or 15% of extra fuel cost	0.15	0 36
Annual extra cost of repairs at 3% on $4.50 per 24 hours	0.06	0 14
	$0.67	$0.96
Annual saving per H. P.	$0.23	$1 64
Or, the saving in per cent. of the annual cost of fuel per H. P. of the compound is	2.3%	5 8%

* This does not apply to the exceptional case of the steamship Iona, having triple-expansion engines expanding the steam 22 times, and consuming 13 35 pounds o. water per hour per horse-power. The average marine triple-expansion engine expands about 11 times, and consumes about 15 pounds of steam per horse-power.

The saving between the compound and triple types is much less than was that involved in the step from the single-expansion condensing to the compound engine. For example, in changing from a 500 horse-power single-expansion twin-cylinder condensing engine expanding six times, with 90 pounds boiler pressure, to the jacketed twin compound, the increased expense to the plant was about $3 per horse-power. The saving of fuel, however, was about four times as great as between the compound and triple types, the water consumption of the single engine being 19 pounds per horse-power. The cost of repairs, oil, etc., was essentially the same. The net saving per annum was, therefore, about 25 and 26 per cent. of the total annual expense for fuel of the single engine for the two rates of working. The increased cost per horse-power of the triple plant over the compound is due almost entirely to the extra cost of the triple engine and its foundations, the boilers costing the same or slightly more, owing to their extra strength. In the case of the single *versus* the compound, however, about one-third of the increased cost of the compound engine is offset by the *less* cost of the latter's boilers.

Also the cost of chimney is about $1 less per horse-power for the compound than for the single system. For larger plants an item of extra labor in the engine room for their proper attendance must be added in the case of the triple plants, no account of which is taken in the present comparison. The figures do not apply to the case of high-speed compound *versus* triple non-condensing engines, regarding performance of which there is as yet no complete data.

Taking the total cost of the plants at $33.50, $36.50 and $41 per horse-power respectively, the figures in the table imply that the total annual saving is as follows for coal at $4 per ton:

1. A compound 500 horse-power plant costs $18,250, and saves about $1 630 for 10 hours service, and $4.885 for 24 hours service per year over a single plant costing $16,750. That is, the compound saves its extra cost in 10-hour service in about one year, or in 24-hour service in four months.

2. A triple 500 horse-power plant costs $20,500, and saves about $114 per year in 10-hour service, or $826 in 24-hour service, over a compound plant, thereby saving its extra cost in 10-hour service in about 19¾ years, or in 24-hour service in about two and three-quarter years.

(To be concluded in a later issue.)

At this writing most of the electrical papers are engaged mainly in discussing the issues of the long-delayed Berliner patents on telephones, which, as we have before explained, were held in the Patent Office for about fourteen years, on account of an "interference," both sides of which were owned by the Bell Company, which managed to defer final action upon the matter until their other patents were near the time of expiration, the object being to prolong their monopoly.

Opinions differ as to whether or not the Bell Company will succeed in its designs; the circumstance which seems to most strongly indicate that it will succeed being the amount of money which it can use in maintaining its position.

Such performances as this do more than anything else to encourage opposition to patent laws and the patent system generally, and it would be better for all who are in any way interested in patents if legislation were enacted making such delays impossible in the future. It is to be hoped that the attention of congress will be called to the matter at the next session, and that the evil will be remedied.

One of our contemporaries in Cincinnati, which would be more esteemed than it is if it were more carefully edited and had a better informed staff of contributors, has for many moons been publishing a thrilling serial work of fiction, entitled "Algebra," from the pen of one of the most persistent of the pennyaliners who contributes so largely to the emptiness of the average trade journals. Upon the appearance of the first chapter, *The Stationary Engineer* called attention to some glaring errors. Subsequent chapters showed no improvement, and when, at the end of the twentieth installment, after more than the usual assortment of mistakes and misstatements, we came to the announcement that the author would leave the subject for the present, with a sigh of relief we turned the page, hoping that the season of respite would be long drawn out. But it is not to be. The turn of the leaf disclosed a second serial, entitled "Practical Mechanics," by the same ignoramus, a specimen of whose lack of mechanical knowledge is to be found in the following extract:

"The motion of a crank is just double that of an eccentric under the same conditions. That is to say, that while a crank of two inches in length from the center of motion to the center of its pin or wrist, and describing a circle of four inches in diameter, will give a reciprocating motion equal to four inches, an eccentric, with the center of motion at one side of its axis two inches, will only move the reciprocating body two inches. Therefore, in order to obtain the same motion from an eccentric as a crank, the center of motion must be distant from its axis just double the radius of the circle described by the crank."

Any schoolboy knows better, and yet the editor of our aforesaid contemporary prints it without comment or correction. Pshaw! The office cat would know better.—*The Weekly Stationary Engineer.*

Out of twenty-four boiler explosions given for the month of August in *The Locomotive*, 3, or over 12 per cent., are saw-mills, and 7, or over 29 per cent., were threshing machines.

Machinists' Supplies and Iron.

NEW YORK, December 12, 1891.

Iron—American Pig—There is a decidedly stronger feeling, and the general expectation seems to be that the improvement is to be a permanent one.

We quote Standard Northern brands, No. 1 Foundry, at $16 to $17; No. 2 is selling at $15 to $16 50, and Grey Forge at $13.75 to $14 50. Southern brands of good quality are obtainable at $16 to $17.50 for No. 1 Foundry; $15.50 to $16 for No. 2; and $14.25 to $14.50 for No. 3.

Scotch Pig—We quote Coltness at $23, and Eglington at $20.50.

Copper—Considerable business has been done in Lake Copper on a basis of 11c. Casting Copper is steady at 10¼c. to 10¾c.

Lead—Buyers are covering only immediate wants, and transactions are confined to small lots. Transactions are upon a basis of 4 27½c to 4 28c.

Lard Oil—Prime City is held at 53c. to 54c.; Western, 52c.

Spelter—Buyers are showing no interest whatever, and values are supposed to be at about 4.70c.

Tin—The general feeling is easier, but no business of any account has been done during the week. Spot price is nominal at 19.98c.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—First-class machinists. Address, The Ticonderoga Machine Company, Ticonderoga, N. Y.

Experienced mechanical draftsman desires position. References. Address K., AM. MACHINIST.

Wanted—Position by mechanical draftsman. References. Address B. C., AMERICAN MACHINIST.

Mechanical draftsman of exp. and tech. education wants position. Draftsman, AM. MACHINIST.

A skilful designer would like situation. Address "Lavater," AMERICAN MACHINIST.

Wanted—Situation as mechanical draftsman. Address Draftsman, 142 Sussex St., Jersey City, N. J.

Skillful pattern maker, accustomed to general work, desires steady position; some experience drafting. Address Steady, BOX 15, AMER. MACH.

Wanted—Position as draftsman on hydraulic and steam work, by an educated and experienced designer. Best of refs. Steam, AMERICAN MACH.

Draftsman with 12 years' experience in general machine drawing and designing, and 4 years' shop exp., desires position. Box 13, care AM. MACHINIST.

An experienced mechanical engineer desires engagement; skillful and accurate in calculating and designing; first-class reference. BOX 14, AM. MACH.

Wanted—Situation by a practical steam engineer and machinist of 15 years' experience; first-class ref. given. Address H. F. Mellor, Rancocas, N. J.

Wanted—A first-class man as assistant manager in bicycle works; must be conversant with machine work and drawing. Apply by letter to the Crawford Manufacturing Company, Hagerstown, Md.

Wanted to employ a blacksmith who is an expert in hardening and tempering all grades of steel; a good place for the right man. Communicate with the Rand Drill Co., North Tarrytown, N. Y.

Wanted—A thoroughly competent man on screw machine work, mainly to work on No. 8 Jones & Lamson. State wages and previous employment. Ott. Mergenthaler & Co., Baltimore, Md.

A practical foundry foreman wants position. Thoroughly understands mixing and melting iron; 25 years' experience in production of soft, light, gray iron castings. Box 433, East Brookfield, Mass.

Wanted—Position by mechanical draftsman, well up in special or light machinery, electricity, German and shorthand; can design and construct. 1st-class references. R. G., Box 49, Flatbush, L. I., N. Y.

Wanted a situation as foundry foreman; eight years' experience in steam-heating and job work; well posted in melting and core making. Address W. C., 401 N. Wells street, Chicago, Ill.

Wanted—Position as supt. or foreman, by a practical engineer and machinist of wide exp. on machine tools, steam engs., and electrical mach'y; well up in modern practice and the economical manage't of men; A1 references. Expert, care AM. MACHINIST.

Wanted—A No. 1 machinist, with good education; practical, progressive and pushing; willing to receive orders and work to company's interest; state wages and experience; give reference. Living cheap; good climate. Address Lathe, AM. MACH.

Mech. draftsman, competent in Webb and cylinder printing presses, with a long exp. generally, wants engagement; a steady, quick worker, able to take charge of room or gang; with excellent ref. from last 6 years' employer. Send answers to R. Gottheil, draftsman, Jersey City Print'g Co., Jersey City, N. J.

Wanted—A position as superintendent of a mechanical industry, by a gentleman who has had 20 years' experience as foreman and superintendent, and is fully competent to systematize and introduce methods for the production of interchangeable or other work on an economical basis. Address "Mechanic," care AMERICAN MACHINIST.

An experienced mechanical engineer, who has successfully filled important positions of charge and responsibility in manufacturing concerns, is open for engagement. Well posted in modern machine shop methods and management, in automatic mach'y and tools for duplicate parts, and in the production of wire; also exp'd in testing and erecting steam plants, and in the transmission of power. A1 references. A. S. M. E., AM. MACH.

A young man who has had charge of the mechanical department of a technical school, wishes, for reasons to be given, to change occupation Would like situation in some manufacturing establishment where he could have a small money interest. Ten years' experience with machinery. Address Box 12, AMERICAN MACHINIST.

✣ MISCELLANEOUS WANTS ✣

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

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Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

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Special leather and cement for covering pulleys, no rivets required; local agents wanted. Crescent Mfg. Company, Cleveland, Ohio.

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Wanted—Engineers to write for catalogue of all the latest and most valuable mechanical, scientific and electrical books which are given free with each barrel of the Pittsburgh Boiler Scale Resolvent. Pittsburgh Boiler Scale Resolvent Co., Pittsb'gh, Pa.

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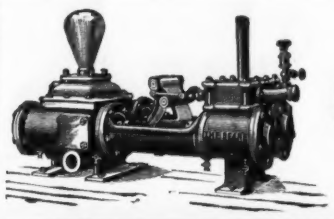

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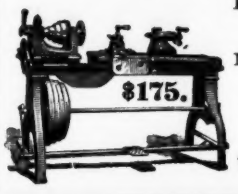

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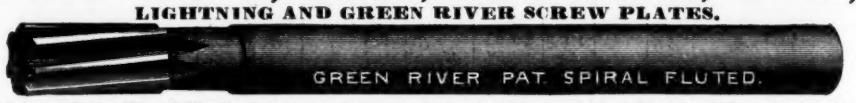

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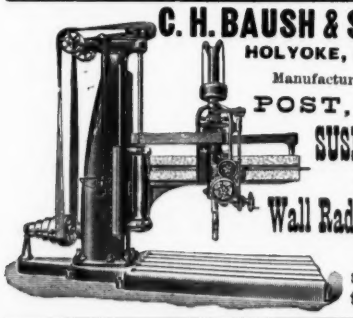

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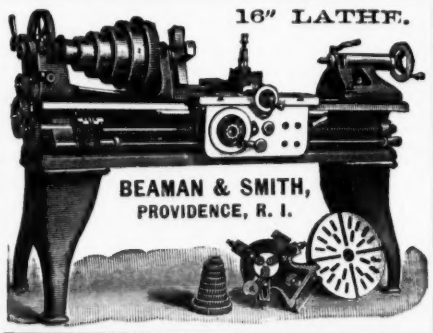

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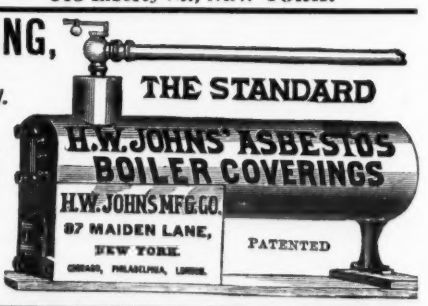

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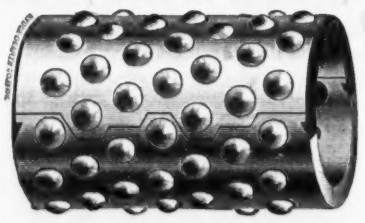

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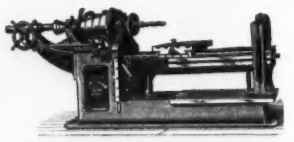
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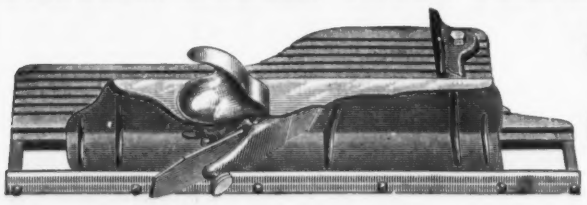

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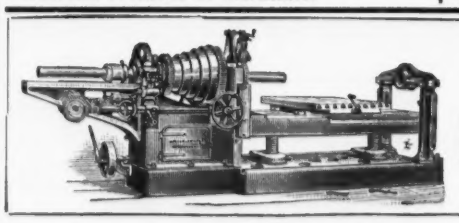

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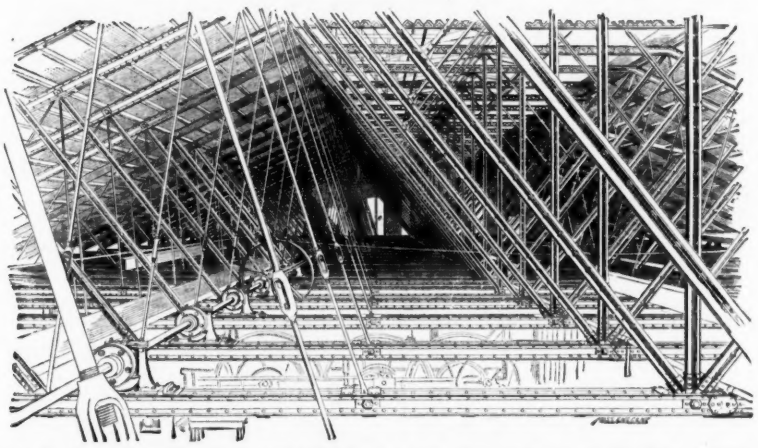

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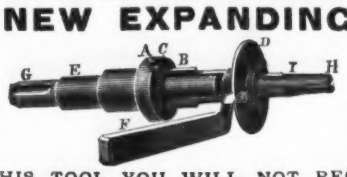

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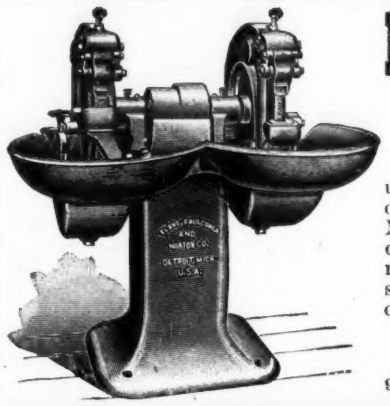

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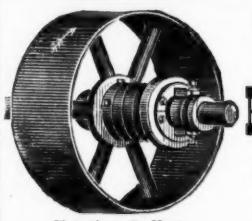

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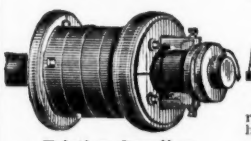

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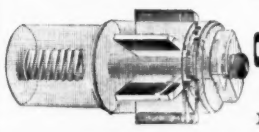
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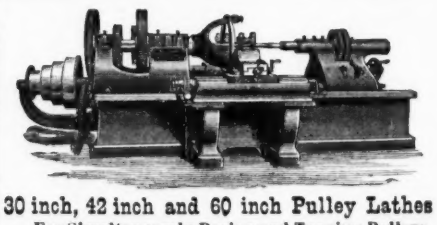

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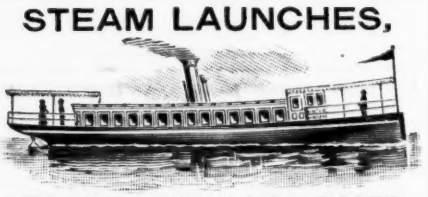

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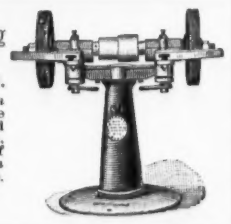

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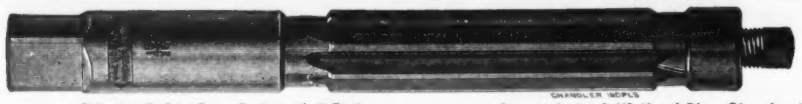

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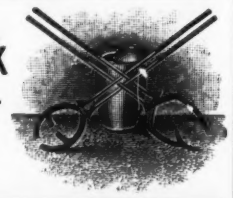

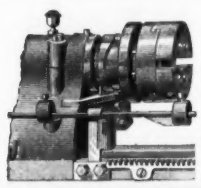

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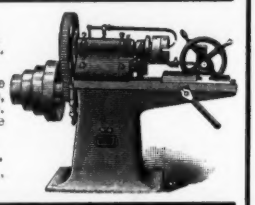

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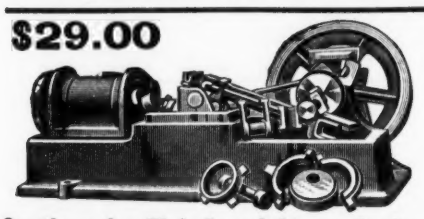

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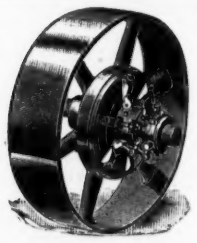

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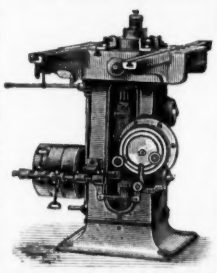

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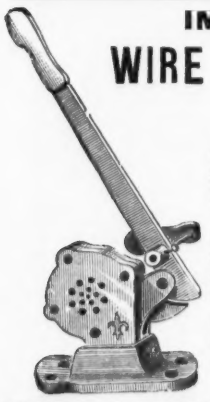

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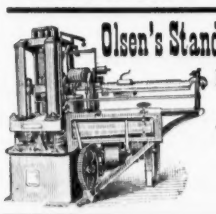

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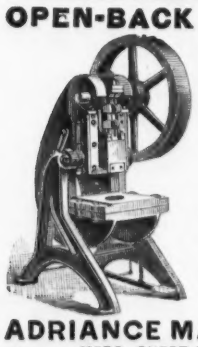

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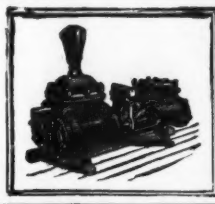

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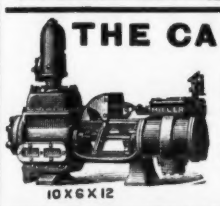

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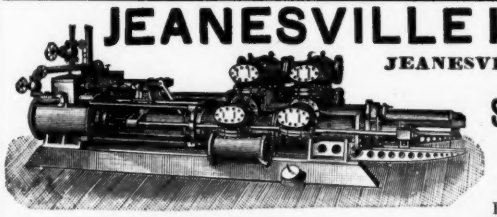

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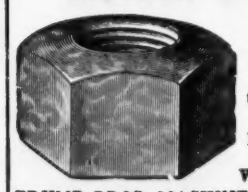

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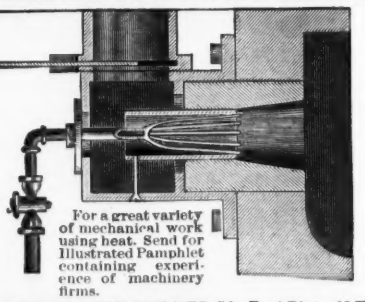

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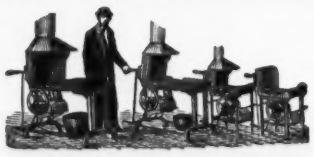

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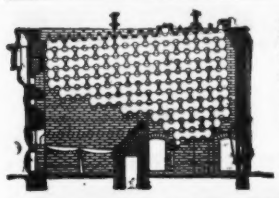

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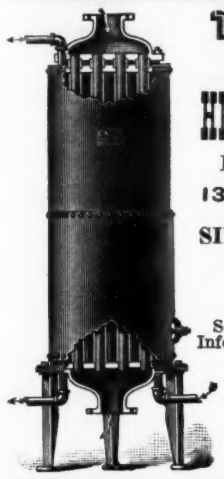

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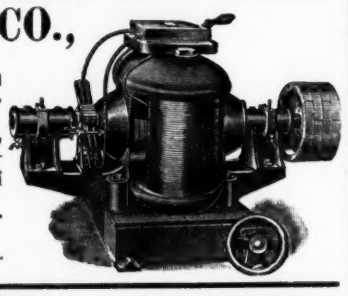

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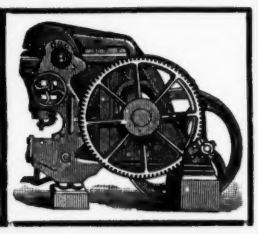

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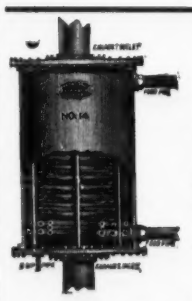

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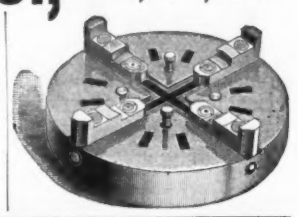

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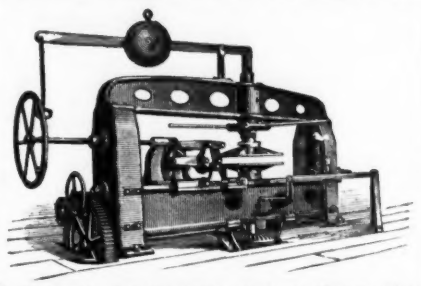

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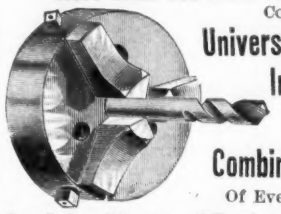

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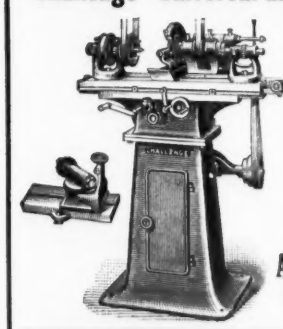

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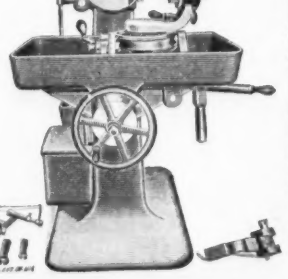

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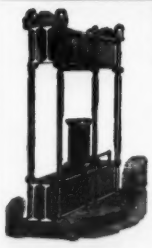

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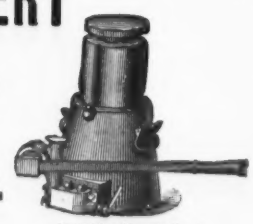

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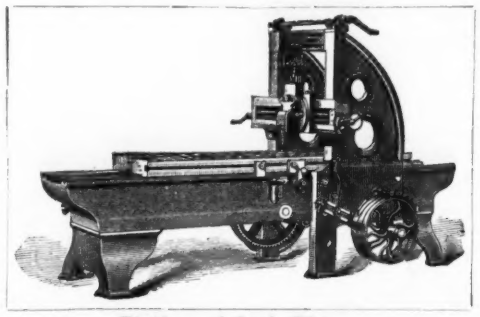

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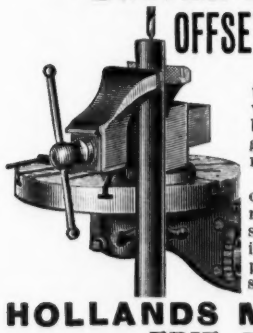

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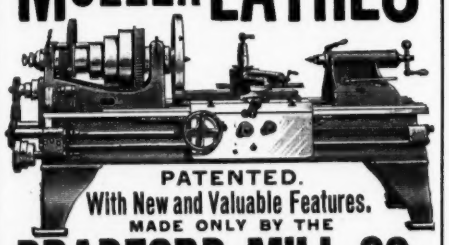

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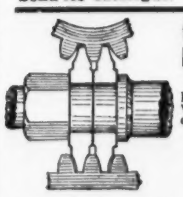

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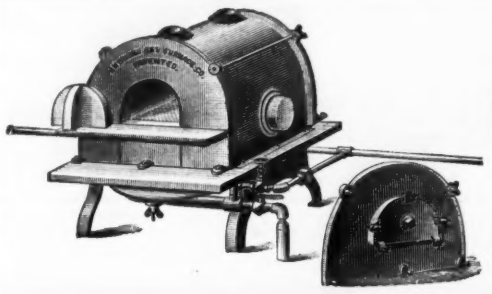

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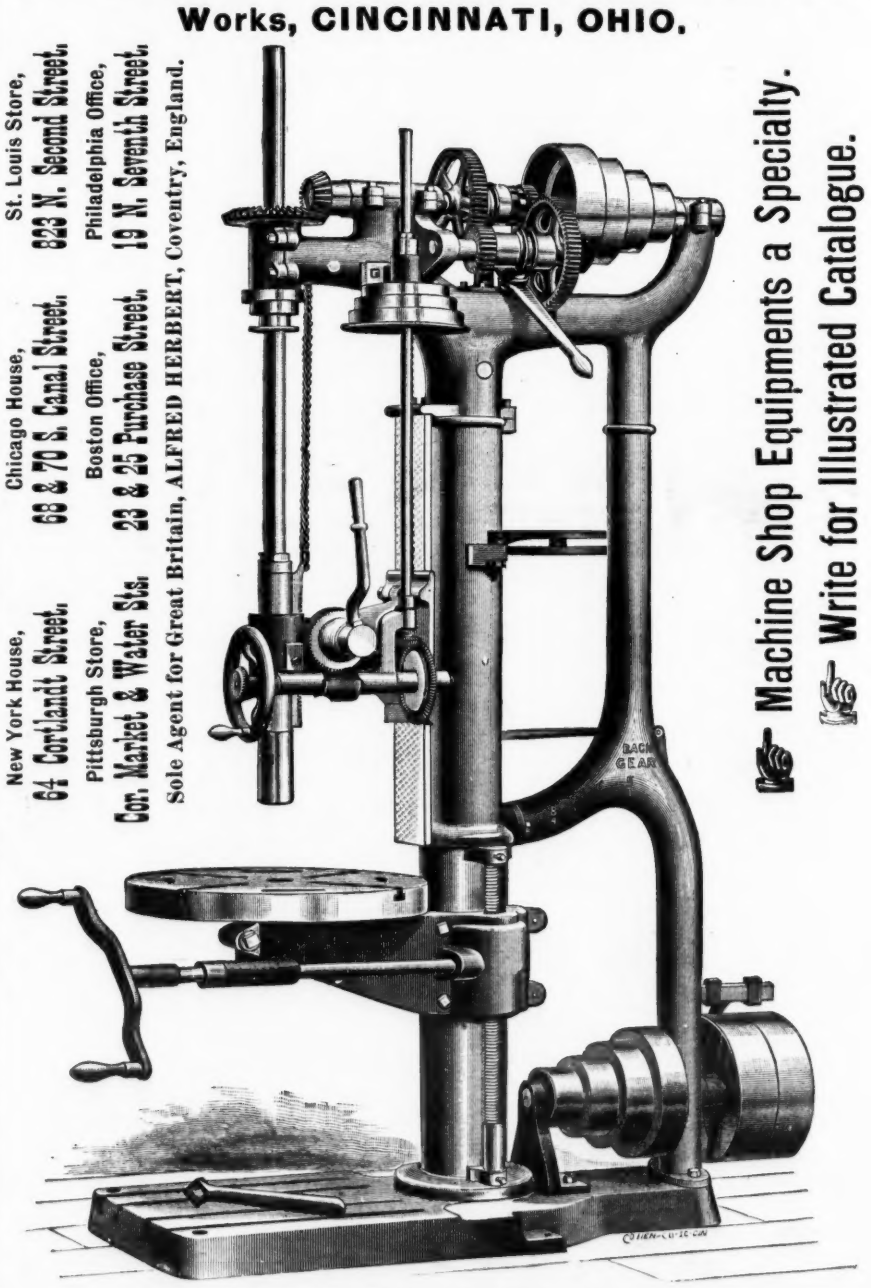

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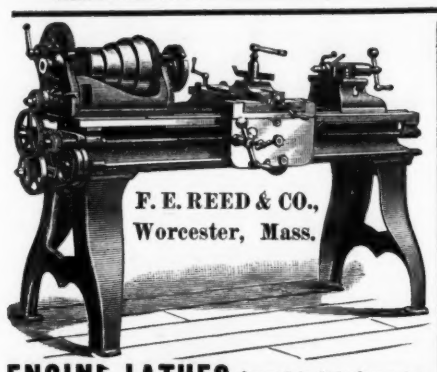

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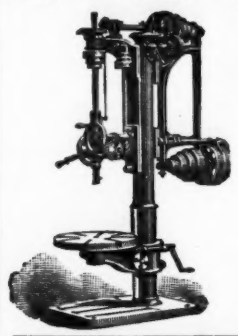

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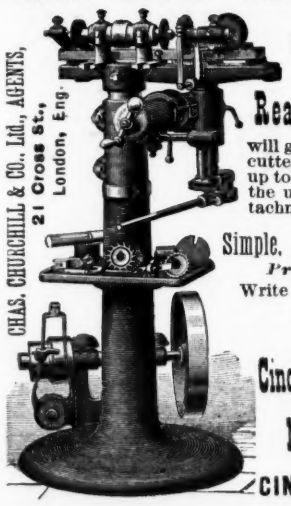

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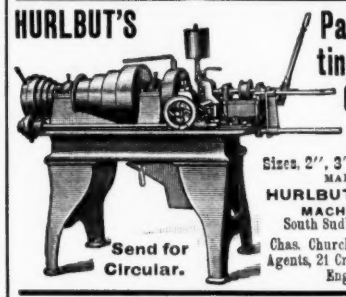

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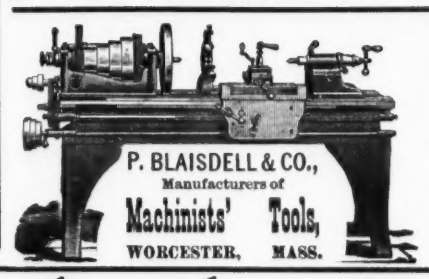

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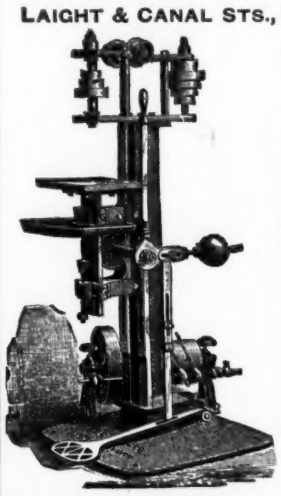

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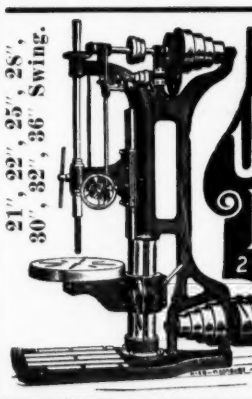

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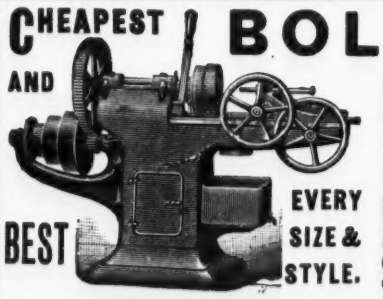

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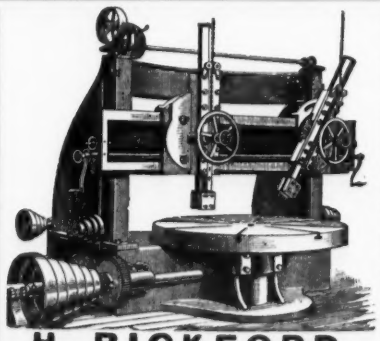

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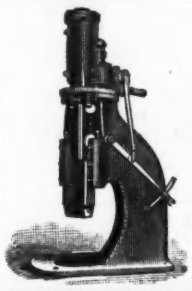

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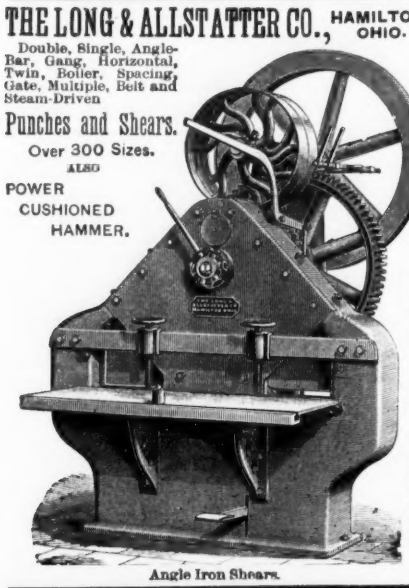

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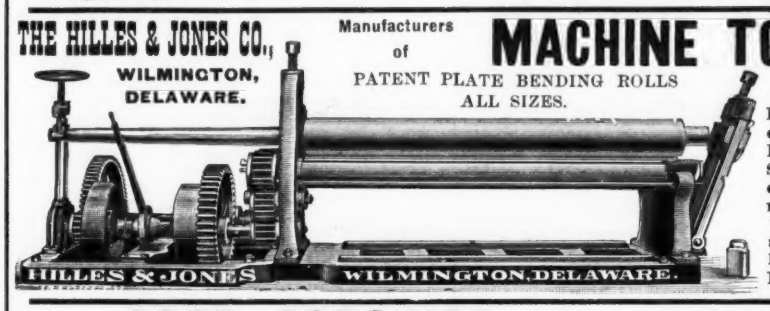

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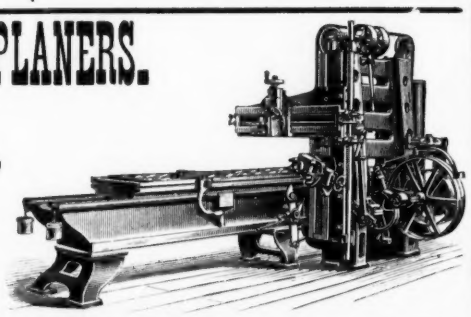

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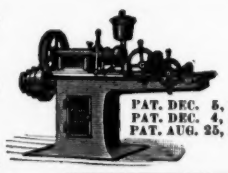

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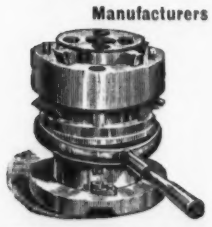

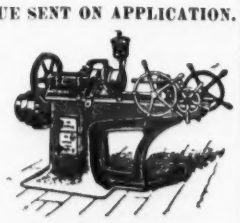

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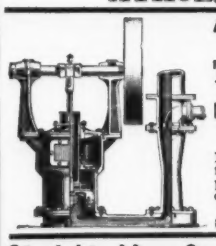

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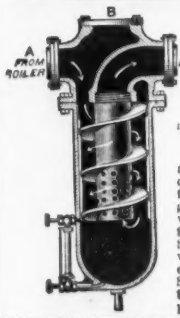

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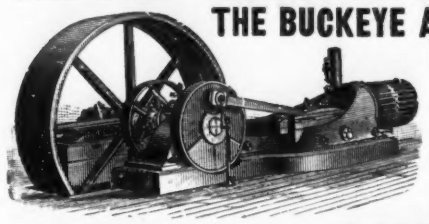

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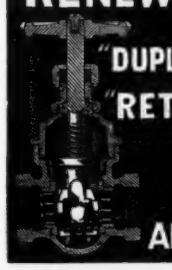

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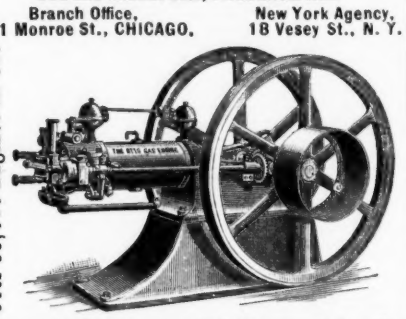

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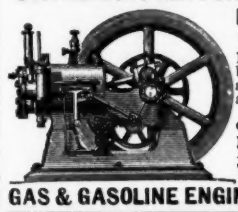

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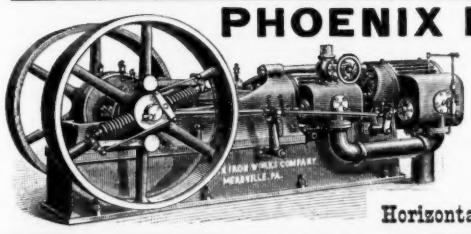

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"	20 in.	"	8-10-12 ft.	beds Standard pattern
"	18 in.	"	8 ft.	bed, Fitchburg
"	18 in.	"	8 ft	bed, Standard pattern.
"	18 in.	"	6-8-10 ft.	beds Hendey.
"	16 in.	"	6-8 ft.	beds Fitchburg.
"	14 in.	"	6 ft.	bed, Hendey, Taper attach
"	14 in.	"	6 ft.	bed, Fitchburg, " "
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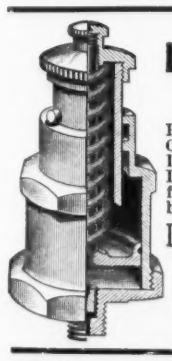

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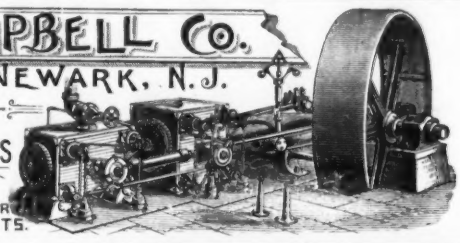

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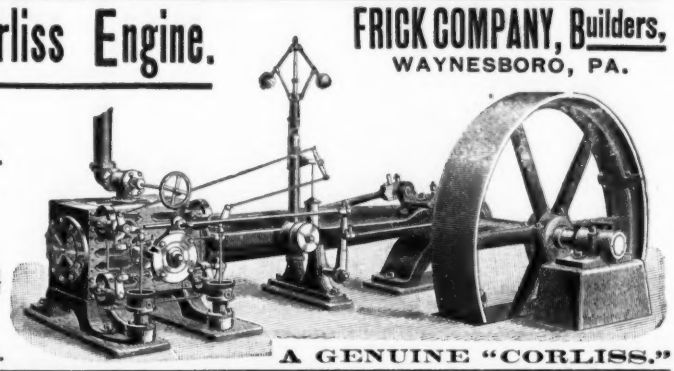

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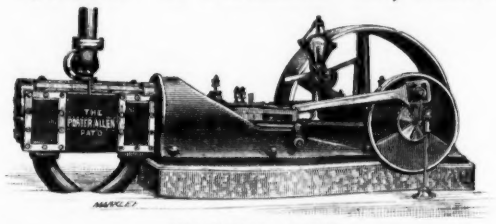

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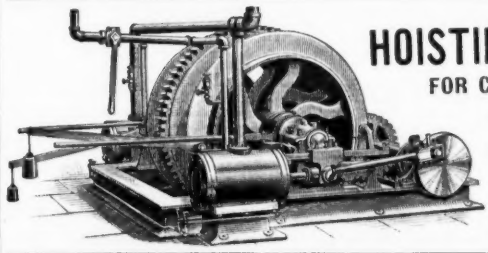

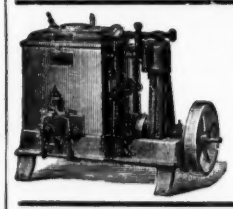

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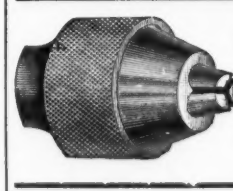

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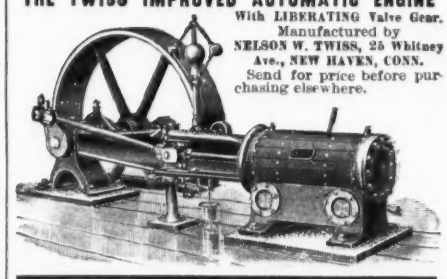

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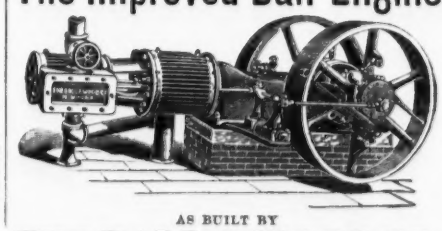

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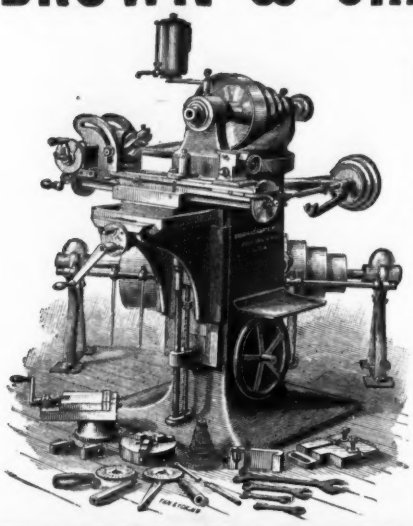

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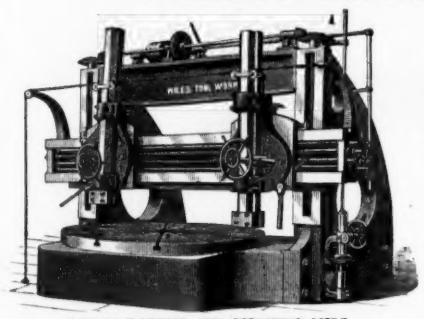

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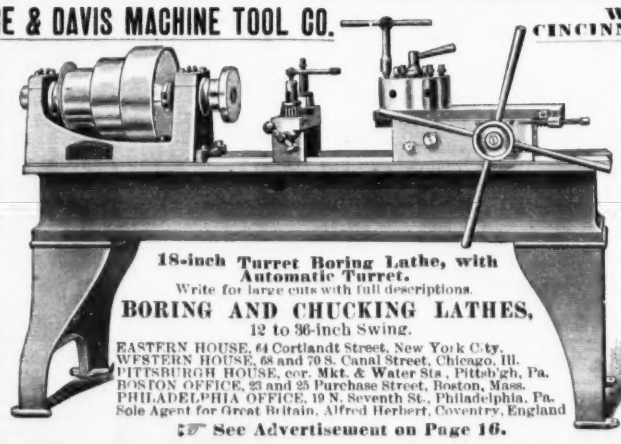

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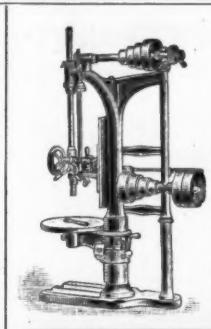

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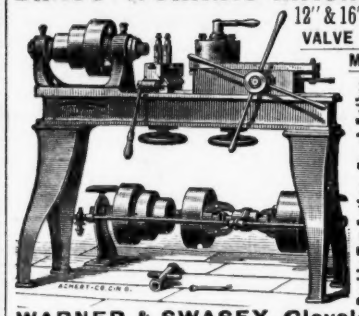

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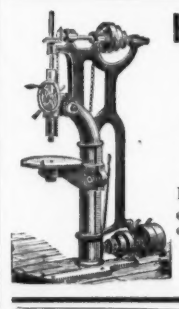

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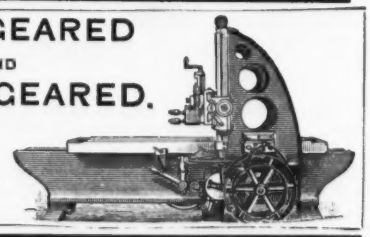

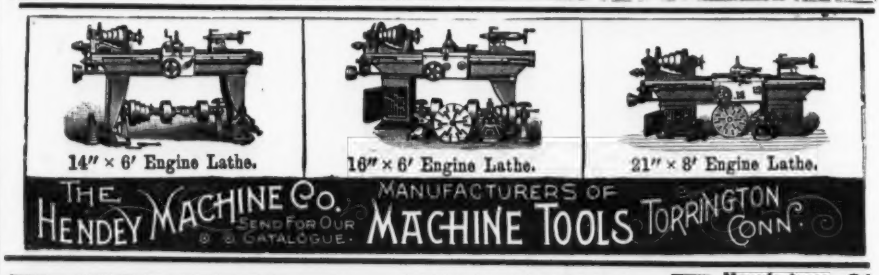

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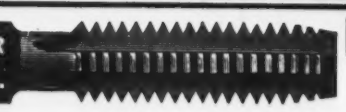
J. M. CARPENTER
PAWTUCKET, R. I.



Manufacturer —of— TAPS & DIES